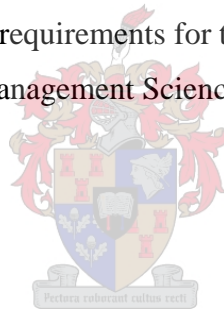


Comparing Five Annuity Options Offered at Retirement in South Africa

by

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Thesis presented in fulfilment of the requirements for the degree Master of Commerce in the
Faculty of Economic and Management Sciences at Stellenbosch University



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DECLARATION

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ABSTRACT

South African citizens are faced with many financial decisions when they reach retirement. One such decision is which annuity to purchase with their pension capital. This study therefore analyses five different annuities available to the South African public in order to provide a better understanding of the value these products offer. The main focus of the analysis was the comparison of present values and ruin probabilities. The annuities examined were living and guaranteed annuities. Four different types of guaranteed annuities were analysed: level, 5% escalating, inflation-linked, and The Complete Picture Pension (TCPP) annuity offered by Sanlam. Eight retiree scenarios were considered with half of these scenarios focusing on spousal couples.

An important conclusion to be drawn from the study is that living annuities are retirement products for those who can ‘afford’ it and who have sufficient financial knowledge. It is recommended that these products only be used as an additional source of income on top of a guaranteed annuity or some other form of income. This study also shows the significant value of guaranteed annuities when an increase in life expectancy is assumed. Furthermore, the industry should research new product structures such as the TCPP annuity, which is a relatively new product, and which shows promising results in this study. Finally, the study emphasises the subjectivity of the annuity decision as the results depend on the retiree(s) circumstances and needs to a large extent.

OPSOMMING

Suid-Afrikaners word met menigte finansiële besluite gekonfronteer wanneer hulle aftree-ouderdom bereik. Een van daardie besluite is watter annuïteit aangekoop moet word met hulle pensioengeld. Hierdie studie ontleed dus vyf verskillende Suid-Afrikaanse annuïteite wat tans beskikbaar is vir die Suid-Afrikaanse publiek. Die ontleding is gedoen met behulp van netto teenswoordige waarde berekeninge en sogenaamde *ruin* waarskynlikhede. Die studie ontleed lewende en gewaarborgde annuïteite. Vier verskillende gewaarborgde annuïteite word ontleed: geen verhoging, 5% verhoging, inflasie-gekoppel en *The Complete Picture Pension* (TCPP) annuïteit wat deur Sanlam aangebied word. Agt verskillende aftree-scenarios word in ag geneem. Vier uit die agt scenarios fokus op getroude pare en die ander vier op enkellopendes.

‘n Belangrike gevolgtrekking wat uit die studie gemaak word is dat lewende annuïteite gepas is vir diegene wat dit wel kan ‘bekostig’ en wat die nodige finansiële kennis het. Dit word aanbeveel dat hierdie produkte slegs as ‘n addisionele bron van inkomste gesien moet word en dat ‘n persoon se primêre inkomste eerder uit ‘n ander bron (gewaarborgde annuïteit of ander inkomste) moet kom. Die studie dui ook op die waarde wat gewaarborgde annuïteite inhou indien ‘n toename in lewensverwagting aanvaar word. Dit word verder aanbeveel dat die industrie nuwe produkte moet ontwikkel, soos die TCPP annuïteit, aangesien hierdie annuïteit belowende resultate toon. Laastens dui die studie ook op die subjektiwiteit van die annuïteit-besluit aangesien die resultate grootliks afhanklik is van die afgetredene(s) se persoonlike omstandighede.

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TABLE OF CONTENTS

DECLARATION	ii
ABSTRACT	iii
OPSOMMING	iv
ACKNOWLEDGEMENTS	v
TABLE OF CONTENTS	vi
LIST OF TABLES	xi
LIST OF FIGURES	xii
GLOSSARY AND LIST OF ABBREVIATIONS	xv
Chapter 1.....	16
Introduction.....	16
Motivation for the Research.....	17
Overview of the Study	18
Chapter 2.....	21
Background to the Study.....	21
2.1 The Retirement Income Provision System.....	21
2.1.1 The Retirement Income Provision System of South Africa.....	26
2.2 South African Annuity Options.....	33
2.2.1 Conventional Annuities	34
2.2.2 Added Annuity Features	40
2.2.3 Living Annuities	41
2.3 Annuities: An International Comparison	42
2.3.1 Australia.....	43
2.3.2 United Kingdom (U.K.)	45
2.3.3 United States of America (U.S.)	48
2.3.4 Nigeria.....	52
2.4 Retirement Industry Reform.....	53
2.4.1 Enabling a Better Income in Retirement.....	55
2.4.2 Preservation, Portability and Governance for Retirement Funds	57
2.4.3 Incentivising non-retirement savings	58
2.4.4 Improving Tax Incentives for Retirement Savings	59
2.4.5 Charges in South African Retirement Funds	60
2.4.6 Reforms Approved for Implementation.....	61
2.5 Conclusion.....	66
Chapter 3.....	68
Literature Review.....	68

3.1	South African Annuity Research Studies.....	68
3.1.1	Baldeaux (2005).....	68
3.1.2	Beinash (2007).....	71
3.1.3	Goemans and Ncube (2008).....	72
3.1.4	Rudman (2009).....	74
3.1.5	Levitan, Dolya and Rusconi (2009).....	76
3.1.6	Lodhia and Swanepoel (2012).....	77
3.1.7	Butler, Hu and Kloppers (2013).....	81
3.1.8	Theron (2013).....	85
3.1.9	De Villiers-Strijdom (2013).....	87
3.1.10	A Comparison of South African Annuity Research.....	88
3.2	International Research Studies.....	93
3.2.1	International Utility-based Annuity Research.....	93
3.2.2	International Risk-Return-based Annuity Research.....	97
3.2.3	Post 2008 Annuity Research.....	100
3.3	Conclusion.....	103
Chapter 4	104
Research Methodology	104
4.1	Simulating Investment Returns.....	104
4.1.1	Collecting Historic Data.....	104
4.2	Generating Investment Returns.....	106
4.2.1	Frequency Distributions.....	106
4.2.2	Calculating the Statistics.....	108
4.2.3	Calculating Dependent Returns.....	109
4.3	Calculating Present Values.....	112
4.3.1	Living Annuity.....	112
4.4	Life Annuities.....	120
4.4.1	Level Annuity.....	121
4.4.2	Escalating Annuity.....	122
4.4.3	Inflation-linked Annuity.....	123
4.4.4	TCPP Annuity.....	125
4.5	Ruin Calculations.....	129
4.5.1	Living Annuity Inflation Model.....	130
4.5.2	Annuity Replacement Models.....	131
Chapter 5	133
Results	133
5.1	Retiree Case 1.....	133

5.1.1	Present Values Analysis.....	133
5.1.2	Percentile Analysis.....	137
5.1.3	Financial Ruin Analysis	139
5.1.4	Annuity-to-Terminal Value Analysis	141
5.1.5	Probability of Outperforming Guaranteed Annuities	143
5.1.6	Annuity Replacement Model	144
5.1.7	Income Stream Comparison.....	146
5.1.8	Conclusion	149
5.2	Retiree Case 2.....	150
5.2.1	Present Values Analysis.....	150
5.2.2	Percentile Analysis.....	153
5.2.3	Financial Ruin Analysis	154
5.2.4	Annuity-to-Terminal Value Analysis	155
5.2.5	Probability of Outperforming Guaranteed Annuities	156
5.2.6	Annuity Replacement Model	157
5.2.7	Income Stream Comparison.....	160
5.2.8	Conclusion	163
5.3	Retiree Case 3.....	164
5.3.1	Present Values Analysis.....	164
5.3.2	Percentile Analysis.....	167
5.3.3	Financial Ruin Analysis	168
5.3.4	Annuity-to-Terminal Value Analysis	169
5.3.5	Probability of Outperforming Guaranteed Annuities	170
5.3.6	Annuity Replacement Model	171
5.3.7	Income Stream Comparison.....	173
5.3.8	Conclusion	176
5.4	Retiree Case 4.....	177
5.4.1	Present Values Analysis.....	177
5.4.2	Percentile Analysis.....	181
5.4.3	Financial Ruin Analysis	182
5.4.4	Annuity-to-Terminal Value Analysis	183
5.4.5	Probability of Outperforming Guaranteed Annuities	184
5.4.6	Annuity Replacement Model	185
5.4.7	Income Stream Comparison.....	188
5.4.8	Conclusion	191
5.5	Retiree Case 5.....	192
5.5.1	Present Values Analysis.....	192

5.5.2	Percentile Analysis.....	195
5.5.3	Financial Ruin Analysis	196
5.5.4	Annuity-to-Terminal Value Analysis	197
5.5.5	Probability of Outperforming Guaranteed Annuities	198
5.5.6	Annuity Replacement Model	199
5.5.7	Income Stream Comparison.....	202
5.5.8	Conclusion	205
5.6	Retiree Case 6.....	206
5.6.1	Present Values Analysis.....	206
5.6.2	Percentile Analysis.....	209
5.6.3	Ruin Analysis.....	210
5.6.4	Annuity-to-Terminal Value Analysis	211
5.6.5	Probability of Outperforming Guaranteed Annuities	212
5.6.6	Annuity Replacement Model	213
5.6.7	Income Stream Comparison.....	215
5.6.8	Conclusion	218
5.7	Retiree Case 7.....	219
5.7.1	Present Values Analysis.....	219
5.7.2	Percentile Analysis.....	222
5.7.3	Financial Ruin Analysis	223
5.7.4	Annuity-to-Terminal Value Analysis	224
5.7.5	Probability of Outperforming Guaranteed Annuities	225
5.7.6	Annuity Replacement Model	226
5.7.7	Income Stream Comparison.....	228
5.7.8	Conclusion	231
5.8	Retiree Case 8.....	232
5.8.1	Present Values Analysis.....	232
5.8.2	Percentile Analysis.....	236
5.8.3	Financial Ruin Analysis	237
5.8.4	Annuity-to-Terminal Value Analysis	238
5.8.5	Probability of Outperforming Guaranteed Annuities	239
5.8.6	Annuity Replacement Model	240
5.8.7	Income Stream Comparison.....	242
5.8.8	Conclusion	245
Chapter 6.....		246
Conclusions, Limitations, and Future Research		246
6.1	Conclusions	246

6.1.1	Retiree Case 1	246
6.1.2	Retiree Case 2	247
6.1.3	Retiree Case 3	247
6.1.4	Retiree Case 4	248
6.1.5	Retiree Case 5	249
6.1.6	Retiree Case 6	249
6.1.7	Retiree Case 7	250
6.1.8	Retiree Case 8	250
6.2	General Conclusions	251
6.2.1	Present Values.....	251
6.2.2	Guaranteed Annuities.....	251
6.2.3	Living Annuities	252
6.2.4	Other Concluding Remarks.....	253
6.3	Limitations of the Study	254
6.4	Future Research.....	255
BIBLIOGRAPHY		256
APPENDIX A		266

LIST OF TABLES

Table 1.1: Retiree Scenarios.....	19
Table 2.1: Current Multiple Contribution Model.....	31
Table 2.2: Tax Deductibility	63
Table 3.1: Ruin Probability Results	77
Table 3.2: Breakeven Framework	78
Table 3.3: Retiree Scenarios.....	82
Table 3.4: Ruin Model Results.....	84
Table 3.5: Probability of Solvency for Certain Ages	86
Table 3.6: Research Comparison	89
Table 3.7: Ruin Probabilities.....	98
Table 4.1: ALSI Frequency Distribution.....	107
Table 4.2: Statistics	108
Table 4.3: Cholesky Decomposition	109
Table 4.4: Independent Returns	110
Table 4.5: Dependent Returns	111
Table 4.6: Dependent Returns.....	112
Table 4.7: Asset Allocations	113
Table 4.8: Living Annuity Fees.....	114
Table 4.9: Asset Management Fees.....	114
Table 4.10: Numerical Example.....	116
Table 4.11: Annuity Quotes	121
Table 4.12: Numerical Example.....	122
Table 4.13: Numerical Example.....	123
Table 4.14: Numerical Example.....	124
Table 4.15: Numerical Example.....	126
Table 4.16: Numerical Example.....	130
Table 4.17: Numerical Example.....	132
Table 5.1: Average Present Value Differences	178
Table 5.2: Initial Annuity Differences	200
Table 5.3: Guaranteed Discount.....	219
Table 5.4: Average Present Value Differences	233

LIST OF FIGURES

Figure 2.1: Retirement Income Provision Systems	22
Figure 2.2: South African Retirement Fund Structures.....	27
Figure 2.3: Annuity Options in South Africa	34
Figure 2.4: Australian Annuity Options	44
Figure 2.5: U.K. Annuity Options	47
Figure 2.6: U.S. Annuity Options	50
Figure 3.1: Annual Annuity Income by Age	79
Figure 3.2: Initial Additional Living Annuity Capital Required.....	80
Figure 5.1: Present Values for all Strategies	135
Figure 5.2: Average Present Values	136
Figure 5.3: Average Present Values (increased life expectancy)	137
Figure 5.4: Present Values in Percentiles	139
Figure 5.5: Ruin % per Year	140
Figure 5.6: Annuity-to-Terminal Value Ratio.....	142
Figure 5.7: Probability of Outperforming Guaranteed Annuities	143
Figure 5.8: Ruin % per Year	145
Figure 5.9: Average Income Streams	147
Figure 5.10: Average Income Streams (increased life expectancy)	148
Figure 5.11: Present Values for all Strategies	151
Figure 5.12: Average Present Values	152
Figure 5.13: Average Present Values (increased life expectancy)	153
Figure 5.14: Present Values in Percentiles	154
Figure 5.15: Ruin % per Year	155
Figure 5.16: Annuity-to-Terminal Value Ratio.....	156
Figure 5.17: Probability of Outperforming Guaranteed Annuities	157
Figure 5.18: Ruin % per Year	159
Figure 5.19: Average Income Streams	161
Figure 5.20: Average Income Streams (increased life expectancy)	162
Figure 5.21: Present Values for all Strategies	165
Figure 5.22: Average Present Values	166
Figure 5.23: Average Present Values (increased life expectancy)	166
Figure 5.24: Present Values in Percentiles	168

Figure 5.25: Ruin % per Year	169
Figure 5.26: Annuity-to-Terminal Value Ratio.....	170
Figure 5.27: Probability of Outperforming Guaranteed Annuities	171
Figure 5.28: Ruin % per Year	172
Figure 5.29: Average Income Streams	174
Figure 5.30: Average Income Streams (increased life expectancy).....	175
Figure 5.31: Present Values for all Strategies	179
Figure 5.32: Average Present Values	180
Figure 5.33: Average Present Values (increased life expectancy).....	180
Figure 5.34: Present Values in Percentiles	182
Figure 5.35: Ruin % per Year	183
Figure 5.36: Annuity-to-Terminal Value Ratio.....	184
Figure 5.37: Probability of Outperforming Guaranteed Annuities	185
Figure 5.38: Ruin % per Year	187
Figure 5.39: Average Income Streams	189
Figure 5.40: Average Income Streams (increased life expectancy).....	190
Figure 5.41: Present Values for all Strategies	193
Figure 5.42: Average Present Values	194
Figure 5.43: Average Present Values (increased life expectancy).....	195
Figure 5.44: Present Values in Percentiles	196
Figure 5.45: Ruin % per Year	197
Figure 5.46: Annuity-to-Terminal Value Ratio.....	198
Figure 5.47: Probability of Outperforming Guaranteed Annuities	199
Figure 5.48: Ruin % per Year	201
Figure 5.49: Average Income Streams	203
Figure 5.50: Average Income Streams (increased life expectancy).....	204
Figure 5.51: Present Values for all Strategies	207
Figure 5.52: Average Present Values	208
Figure 5.53: Average Present Values (increased life expectancy).....	208
Figure 5.54: Present Values in Percentiles	210
Figure 5.55: Ruin % per Year	211
Figure 5.56: Annuity-to-Terminal Value Ratio.....	212
Figure 5.57: Probability of Outperforming Guaranteed Annuities	213
Figure 5.58: Ruin % per Year	214

Figure 5.59: Average Income Streams	216
Figure 5.60: Average Income Streams (increased life expectancy).....	217
Figure 5.61: Present Values for all Strategies	220
Figure 5.62: Average Present Values	221
Figure 5.63: Average Present Values (increased life expectancy).....	222
Figure 5.64: Present Values in Percentiles	223
Figure 5.65: Ruin % per Year	224
Figure 5.66: Annuity-to-Terminal Value Ratio.....	225
Figure 5.67: Probability of Outperforming Guaranteed Annuities	226
Figure 5.68: Ruin % per Year	227
Figure 5.69: Average Income Streams	229
Figure 5.70: Average Income Streams (increased life expectancy).....	230
Figure 5.71: Present Values for all Strategies	234
Figure 5.72: Average Present Values	235
Figure 5.73: Average Present Values (increased life expectancy).....	235
Figure 5.74: Present Values in Percentiles	237
Figure 5.75: Ruin % per Year	238
Figure 5.76: Annuity-to-Terminal Value Ratio.....	239
Figure 5.77: Probability of Outperforming Guaranteed Annuities	240
Figure 5.78: Ruin % per Year	241
Figure 5.79: Average Income Streams	243
Figure 5.80: Average Income Streams (increased life expectancy).....	244

GLOSSARY AND LIST OF ABBREVIATIONS

Word / Abbreviation	Definition
AA	Asset Allocation
ALBI	All Bond Index
ALDA	Advanced Life Deferred Annuity
ALSI	All Share Index
ARM	Annuity Replacement Model
Annuity (1)	A financial product purchased, usually at retirement, which provides an income stream.
Annuity (2)	The amount paid by the annuity product to the annuity holder. This word is used interchangeably with ‘benefit(s)’.
Annuitant	The legal holder of the annuity product and the rightful owner of the annuity benefits. This word is used interchangeably with ‘retiree’ and ‘pensioner’.
ASISA	The Association for Savings and Investments South Africa
CPI	Consumer Price Index
DB	Defined Benefit
DC	Defined Contribution
ELA	Equity-linked Annuity
ELID	Equity-linked Income Drawdown
EPoR	Eventual Probability of Ruin
GLWB	Guaranteed Lifetime Withdrawal Benefit
GMAB	Guaranteed Minimum Accumulation Benefit
GMDB	Guaranteed Minimum Death Benefit
GMIB	Guaranteed Minimum Income Benefit
GMWB	Guaranteed Minimum Withdrawal Benefit
JSE	Johannesburg Stock Exchange
LPoR	Lifetime Probability of Ruin
MSCI	Morgan Stanley Capital International
MWR	Money Worth Ratio
NFF	Net Fee Factor
NRR	Net Replacement Ratio
RIT	Retirement Income Trust
SARS	South African Revenue Service
Stochastic	A non-deterministic modulation wherein the results are determined probabilistically.
TCPP	The Complete Picture Pension
ZAR	South African Rand

Chapter 1

Introduction

According to the Sanlam Benchmark Survey (2014) 54.4% of pensioners are of the opinion that they have not saved enough for retirement and that their capital will not last for the rest of their lives. 30% reported a shortfall between their current monthly retirement income and their monthly living expenses in 2010 and this figure increased to 60% in 2014. To further stress these figures, 73.7% of the pensioners in this survey retired in the past ten years and 49.4% retired in the past five.

83% of respondents in the FinScope Survey (2012) do not own a retirement, pension or provident fund product. According to this survey, 48% of adults currently contributing to some form of retirement savings product are concerned that they won't have saved enough money when they reach retirement age. Only 10% of adults who are saving for retirement or old age regard saving for retirement as important (FinScope Survey, 2012).

These statistics provide a grim outlook for the South African retirement industry. The statistics are clearly visible in everyday life as pensioners' poverty has long been a part of our society (May, 2003). The problem has escalated to such an extent that government is set to implement certain policies and regulations in order to address it. The statistics also provide a guideline for potential solutions, although the solutions will not be straightforward. In essence individuals start saving too late for their retirement. The Sanlam Benchmark Survey (2014) reported that 72.9% of pensioner respondents advised younger generations to either invest or save from an early age, or to start planning for retirement from an earlier age.

Even if retirees start saving early enough they might not deem it as important and subsequently do not contribute as large a percentage of their salary toward retirement as would be most advantageous. Furthermore, when people move from one employer to another they are prone to spend the full amount that they have saved with their current employer's retirement fund as opposed to reinvesting it in a preservation fund (National Treasury, 2013b).

One can also argue that a behavioural bias is present when thinking about retirement. As retirement represents the final phase of one's life, there are not many who wish to think about it. The younger generation does not regard it as an important matter whilst the older

generation prefers not to think about it. Also, many people don't have the necessary financial knowledge to make prudent investment decisions, regardless of their age.

Undoubtedly there is no one clear-cut solution to the problem of old age poverty. An entire population's way of thinking would need to be changed and a new retirement savings culture would have to be nurtured. Thus, addressing the source of the problem is a long-term process and while that is underway the retirees of today and tomorrow are no better off. They are now in the position where they need to decide what the next financial step in their lives should be.

According to the Income Tax Act (No. 52 of 1962), two-thirds of the amount in a pensioner's retirement fund has to be used to purchase an annuity (National Treasury, 2012d; Republic of South Africa, 1962). This leaves retirees with a very important decision to make – with all the different annuity products and options available, how can they be assured of selecting the correct one?

Though it is argued that the root of the retirement problem lies in the fact that retirees have not saved enough throughout their working career, the retirees of today still need to make sound financial decisions with regards to the obligatory purchase of a retirement annuity. It is necessary to assist retirees in the annuity decision so as to provide a level of income assurance.

Thus, in order to assist future retirees to make sound financial decisions, five annuity options that are available to South African citizens will be analysed. The aim is to provide retirees with clarity surrounding the decision of which annuity to purchase. Although they are unsure of whether or not their savings will be sufficient to last for the rest of their lives, they can retire with the certainty that they have made the best possible financial decision. One would argue that those who retire after a life of dedication to their specific occupation deserve to do so with dignity and certainty. Retirement should not be a stressful, uncertain or unpleasant procedure, but rather one to which the retiree can look forward to.

Motivation for the Research

To the author's knowledge there are nine South African based annuity research studies. Five of these studies were conducted in completion of Master's degrees or piloted by qualified actuaries. The other four studies were in completion of an Honours or MBA degree and

consequently aren't as comprehensive as the other five. These studies usually differ in terms of five variables that are either simulated or assumed. These include, but are not limited to: types of annuities analysed, pensioners' details (age, gender and life expectancy), annuity fees, inflation, and investable asset classes.

Currently no South African based research has been conducted where five annuity products are compared in one study. The largest number of annuities analysed in one study was four different products.

Furthermore, the study by Butler, Hu and Kloppers (2013) is the only study to have included joint-life annuity options in analysing different annuities. The joint-life annuity option allows for the surviving spouse, after the death of the main member in the annuity contract, to continue receiving a specific percentage of the original annuity. This is deemed to be a very important aspect, as 60.4% of pensioner respondents in the Sanlam Benchmark Survey (2014) are still married. Previous studies, apart from Butler, *et al.* (2013), ignore this fact and analyse annuity options in terms of a single life male or female retiree.

This study also allowed for a variety of asset classes from a living annuity perspective. Most of the previous studies only included local equities and bonds. This study includes local equities and bonds, international equities and bonds, as well as local property.

Overview of the Study

The annuities analysed in this study were examined in order to provide a better understanding of the value these products offer to retirees. The analysis was conducted mainly by means of a present value analysis, i.e. comparing the future income streams of different types of South African annuities on a current day basis. Ruin probabilities were also introduced and gave an indication of the sustainability of living annuities. The analysis was conducted on a forward-looking basis by means of a Monte Carlo simulation. This simulation discounted the income streams from the annuities analysed under various investment return scenarios.

The annuities examined were living and guaranteed annuities. Four different types of guaranteed annuities were analysed: level, 5% escalating, inflation-linked, and The Complete Picture Pension (TCPP) annuity offered by Sanlam. A with-profit annuity was also considered for this study but due to the significant simulation challenges it poses it was not included.

Furthermore, the product is unpopular amongst retirees as few people are purchasing it at retirement (Goemans & Ncube, 2008:25).

An important caveat should be raised in terms of the investment return simulations. According to Pfau (2010:56) South Africa has experienced the third highest real equity return for the period 1900 to 2008 of all the countries analysed in the Dimson, Marsh and Staunton (2002) database. This database contains investment returns and data for equities, bonds, treasury bills, currencies and inflation from 16 different countries over a 108 year period. The database has since been expanded to included data from 26 countries over a 115 year period.

This caveat could lead to a biased conclusion in favour of living annuities when dealing with historic South African returns. Still, this does not change the fact that some studies present sound arguments in favour of living annuities. The investment performance caveat of South African markets is merely raised to serve as justification for Monte Carlo simulations. These simulations include outliers, such as best and worst case scenarios, and can subsequently contribute to a more comprehensive study.

Eight retiree scenarios were considered. These scenarios are presented in Table 1.1. It was assumed that the annuitant(s) retired on 1 January 2015. The life expectancy figures in the table were obtained from the a(55) life mortality table as published by the Cambridge University Press in 1953 (Botha, Rossini, Geach, Goodall & Du Preez, 2011:1056). This mortality table states that males aged 55, 60, 65 and 70 have respective life expectancies of 21.445, 17.520, 13.936 and 10.774 years. Females aged 52, 57, 62 and 67 have respective life expectancies of 27.957, 23.643, 19.526 and 15.690 years. These numbers were rounded to the nearest year.

Table 1.1: Retiree Scenarios

Case	Age	Gender	Life Expectancy	Spouse Age	Spouse Gender	Spouse Life Expectancy
1	55	Male	21	-	-	-
2	60	Male	18	-	-	-
3	65	Male	14	-	-	-
4	70	Male	11	-	-	-
5	55	Male	21	52	Female	28
6	60	Male	18	57	Female	24
7	65	Male	14	62	Female	20
8	70	Male	11	67	Female	16

Source: Author (2015)

The returns of six asset classes, as well as inflation, were modelled as living annuitants may invest in a diverse range of assets. Investment returns were simulated for local equities (JSE All Share Index – ALSI), local bonds (JSE All Bond Index – ALBI), JSE Top 40 Index, local property (J255 Property Unit Trust Index), international equities (Morgan Stanley Capital International MXWO Index), and international bonds (JP Morgan Global Bond Index). Inflation was simulated for discounting purposes. Three initial drawdown strategies were tested: 2.5%, 5% and 7.5%. The living annuitant was assumed to increase his drawdown percentage by the previous year's inflation rate.

Chapter 2

Background to the Study

This chapter provides an overview of the current international retirement industry with specific focus on the South African system. Section 2.1 provides an introduction to the functionality of current retirement income provision systems on an international level and then presents the case for South Africa. Section 2.2 discusses the different types of post-retirement income strategies, or annuity products, currently offered by the South African private sector. The specific retirement income provision systems and annuity markets of four other countries are presented in Section 2.3. The chapter concludes with Section 2.4 which provides an overview of the reforms currently taking place within the South African retirement market.

It should be stressed that this chapter contains information as at the time of writing (the years 2014 and 2015).

2.1 The Retirement Income Provision System

Retirement income provision is a process which starts when an individual first makes a contribution to a retirement fund and ends when the individual formally retires (OECD, 2013:132). This process, on an international and national level, is explained in greater detail in this section.

The provision for retirement income, on an international level, can be classified in three tiers (OECD, 2013:120). This implies that provision for retirement income can be divided into three general sections. The three tiers are displayed in Figure 2.1.

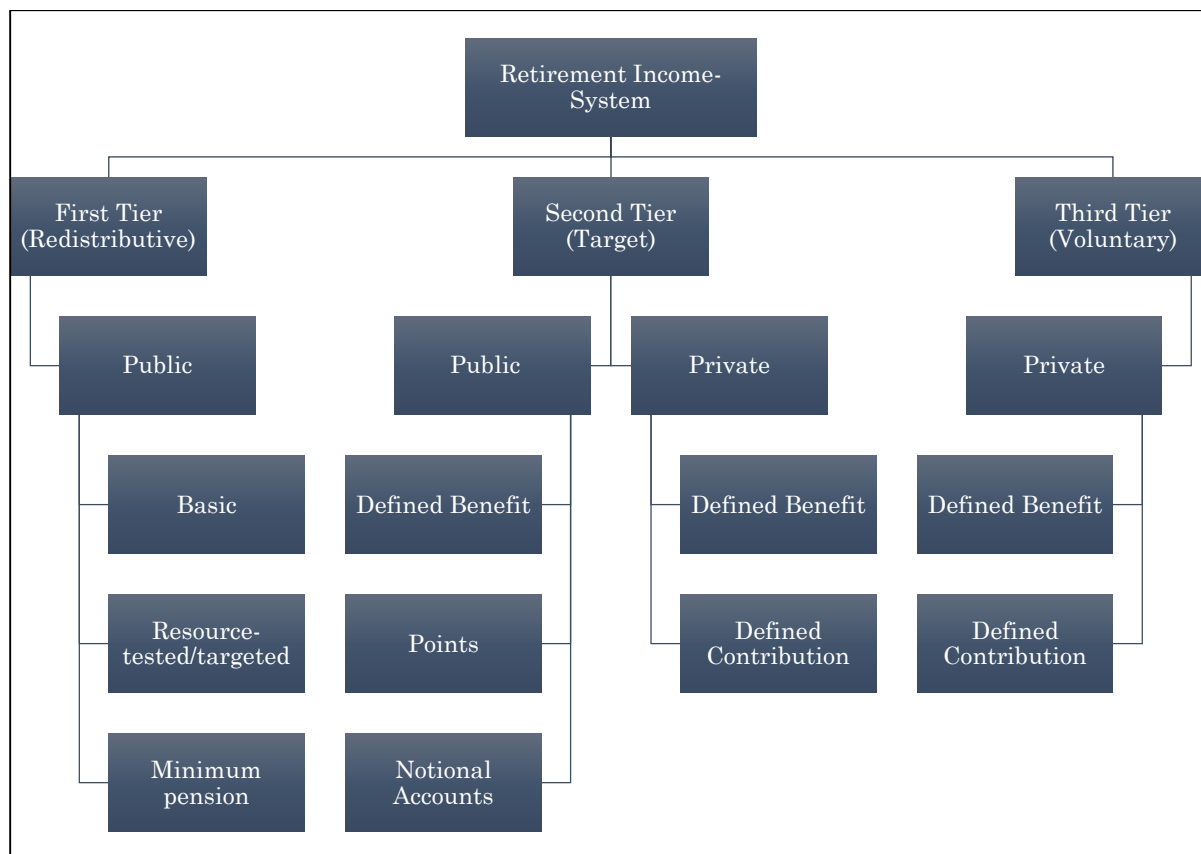


Figure 2.1: Retirement Income Provision Systems

Source: OECD (2013:121)

These three tiers each represent different systems of retirement income provision. It is important to note that this is a representative diagram of pension systems as employed by most countries. More specifically, these structures are based on the Organisation for Economic Co-operation and Development (OECD) member countries. The primary objective of the organisation is to “promote policies that will improve the economic and social well-being of people around the world” (OECD, 2014). The OECD specifically works in partnership with national governments in order to find solutions to everyday problems. Whitehouse (2007:3) claims that the above diagram is a comprehensive model of international pension structures and is thus also applicable to non-OECD countries.

A country can technically implement these tiers in any way it deems most beneficial. The tiers are classified firstly according to the pension structure provider, and secondly according to the way in which the benefits, or pensions, are calculated.

The First Tier, labelled Redistributive, is designed to ensure that all pensioners in a country realise a minimum standard of living. The Second Tier, labelled Target, has the intended objective of achieving a targeted standard of living in retirement compared with the standard which was maintained during the working career of an individual. The Third Tier, labelled Voluntary, offers individuals the option of purchasing products such as annuities with voluntary pension savings (OECD, 2013:120).

Providers of these tiers can either be the public or private sector. The public sector is defined as programmes that are administered by governments that have the set objective of providing an income to individuals in retirement. The private sector is defined as having the same objective, but is administered by institutions other than local governments, such as life companies (OECD, 2005b:12). As can be seen from the second level of Figure 2.1, the First Tier is only offered by governments themselves, while the Second Tier is provided by either governments or private institutions, and the Third Tier is solely provided by private institutions. The way in which the benefits are calculated, or what type of pension is offered, is explained below.

The First Tier generally pays out a basic, resource-tested, or minimum pension to retirees (OECD, 2013:120).

Basic schemes either pay the same amount to all pensioners or the pension amount is a factor of the duration of an individual's working career. Furthermore, any additional retirement income does not change the entitlement (OECD, 2013:120).

Resource-tested schemes pay out higher pensions to poorer retirees and lower pensions to the more affluent retirees. There are three tests of which either one is generally followed in determining the benefit that will be received by pensioners: pension income tested, broader income tested, and broader means-tested. The pension income test depends only on the level of pension income a retiree receives and pays out a pension accordingly. The broader income test will pay a reduced benefit should the retiree receive income from other personal savings. The broader means test takes into account personal savings and personal assets (OECD, 2005a:23).

Minimum pension schemes follow a similar approach to that of resource-tested schemes. These schemes differ in the institutional set-up and eligibility conditions. Retirees must also

have contributed to a pension fund for a minimum number of years in order to receive this benefit (OECD, 2005a:23).

The Second Tier follows one of four provision systems depending on the sector from which it is being offered. The objective is to ensure that pensioners will be able to have an adequate standard of living in the retirement phase of their lives compared to what they maintained during their working careers. It is not just an old-age poverty prevention tier such as Tier One (Whitehouse, 2007:8).

When these Second Tier schemes are offered by institutions other than national governments, i.e. the private market, the provision system is generally structured as a Defined Benefit (DB), or Defined Contribution (DC) scheme.

Under a DB scheme members may, together with their employer, contribute a certain percentage of their monthly salary to the DB fund. These funds are then pooled together and invested by professional asset managers. An employer who offers a DB plan is obligated to pay plan members a lifelong benefit, or annuity, during the retirement phase of their lives. The annuity to be received is typically based on the annuitant's final salary and the number of years devoted to the employer (Beth & Forna, 2008:2). Other benefit factors may also be used such as calculating the benefit based on employees' average earnings over their entire working career (Beth & Forna, 2008:19). The annuity paid to the employee will be funded by the underlying investment fund.

Under this structure the employee receives a guaranteed income in retirement and all risks are borne by the employer. There are mainly four risks a DB scheme is exposed to, namely investment, longevity, sequencing, and interest rate risk. Investment risk is defined as the underperformance of the underlying retirement assets pre- and post-retirement and the subsequent increase in risk of not being able to obtain, or maintain, a sufficient income in retirement. Longevity risk is the risk that the retiree might outlive the average life expectancy and thus would have to be sustained financially for longer. Sequencing risk is defined as the specific date of retirement. An individual retiring amidst an economic downturn will require a significant time to recover the initial depletion of retirement assets. Finally, interest rate risk is the risk of purchasing an annuity when interest rates are low as subsequent annuity benefits receivable will also be low (Mercer, 2013:18).

A DC plan differs from a DB plan in a number of ways. First and foremost, the employee assumes the investment and longevity risk. At retirement, the retiree is obligated to purchase an annuity with a certain percentage of the accumulated retirement funds. Contributions to the fund will be made by the employer and employee for the duration of the employee's career. These contributions are a certain percentage of the employee's monthly salary. In some countries such as Hungary, Mexico and Poland, DC schemes are entirely individual, i.e. employees choose a pension provider without any employer involvement (OECD, 2005a:24). It is important to note that the annuity to be received at retirement differs substantially from DB schemes. The annuity is typically a factor of the accumulated retirement interest in the fund on retirement date as well as other factors such as annuity rates or market performance depending on the type of annuity selected (De Scally, 2013). What makes DC plans attractive to employees is the fact that they have full discretion as to how their retirement savings should be invested.

When these Second Tier schemes are offered by national governments, i.e. the public sector, the provision system follows a DB, Points, or Notional Accounts structure.

DB schemes are the most common public pension provision system adopted and function in the same way as explained in the case of the private sector, only from a government perspective.

If a DB structure is not followed some countries employ a Points system. This system is currently applied by the French occupational plans and the German, Norwegian and Slovak public schemes. Employees earn pension points based on their individual earnings for each contributing year. At retirement, the sum of their pension points is multiplied by a pension-point value to convert them into a regular pension payment (OECD, 2005a:24).

Finally, a Notional Accounts system is employed by the public plans of Italy, Poland, and Sweden. These schemes operate like DC schemes in that employees' contributions are not pooled together. They differ, however, in the sense that the government sets a minimum rate of return that the scheme must pay and also determines a mandatory annuity rate at which the accumulation is converted into pension payments (OECD, 2005a:25).

The Third Tier is only offered by the private sector and follows either a DB or DC provision system. These operate in exactly the same way as explained under the Second Tier.

2.1.1 The Retirement Income Provision System of South Africa

This section describes the retirement income provision system of South Africa. It is important to have an understanding of this system as it is the foundation of this study. It is also important to note that this study was conducted over the course of 2014 and 2015. Subsequently, legislative changes in the industry also have to be taken into account and are therefore discussed in the relevant sections below.

2.1.1.1 South African Retirement Tiers

South Africa implements all three tiers depicted in Figure 2.1. The First Tier is in the form of an old age grant provided by the government and is currently equal to R1 420 per month. Eligibility for this grant is tested by way of a resource (broader means) test, i.e. eligibility depends on the pensioner's income and assets and is only payable from age 60 (National Treasury, 2012a:28). Currently, the income and asset criteria are as follows: a single living individual may not earn more than R64 680 per year or own assets worth more than R930 600. If the individual is married, the couple may not have a combined income of more than R129 360 per year and own assets worth more than R1 861 200 (Old Age Grant, 2015). The means test is, however, set to be phased out by 2016. The grant will be made available to all citizens over a certain age (National Treasury, 2013a:11). It should be noted that these Rand amounts usually change at annual budget speeches and the amounts mentioned here are applicable to the 2015/16 fiscal year.

The Second Tier, a public DB pension fund, ensures that government employees receive a certain level of benefit from government during the retirement phase of their lives. The normal retirement age is 60 at which point employees will start receiving benefits. However, employees are allowed to opt for receiving retirement benefits as from the age of 55, subject to certain penalties. A reduction of a third of a percent from the benefit receivable at the normal retirement age will be applied for each month between the dates of early retirement and normal retirement (GEPPF, 2014).

The Third Tier represents the voluntary, private provision system and consists of different types of retirement funds. In a South African context, this tier can be structured on an employer and an individual level (Van Den Heever, 2007:2). This implies that individuals can be members of their employers' retirement fund as well as any other retirement fund offered

by non-government institutions. The individual funds also exist to provide those employees whose employers do not have a retirement fund with the opportunity to save for retirement, as it is not required by law for employers to offer retirement funds (De Scally, 2014). It is thus not compulsory to save for retirement in South Africa. However, an employer that does have a retirement fund usually makes it compulsory for employees to contribute to the company's fund (Liberty Corporate, 2012:13). National Treasury, as part of the retirement industry reform, has made it a medium term goal to implement certain measures which would make saving for retirement compulsory (National Treasury, 2014b:12). Figure 2.2 depicts the different retirement funds offered by employers and individual structures, and also incorporates the DB and DC fund schemes because certain funds can only be structured as one of these schemes.

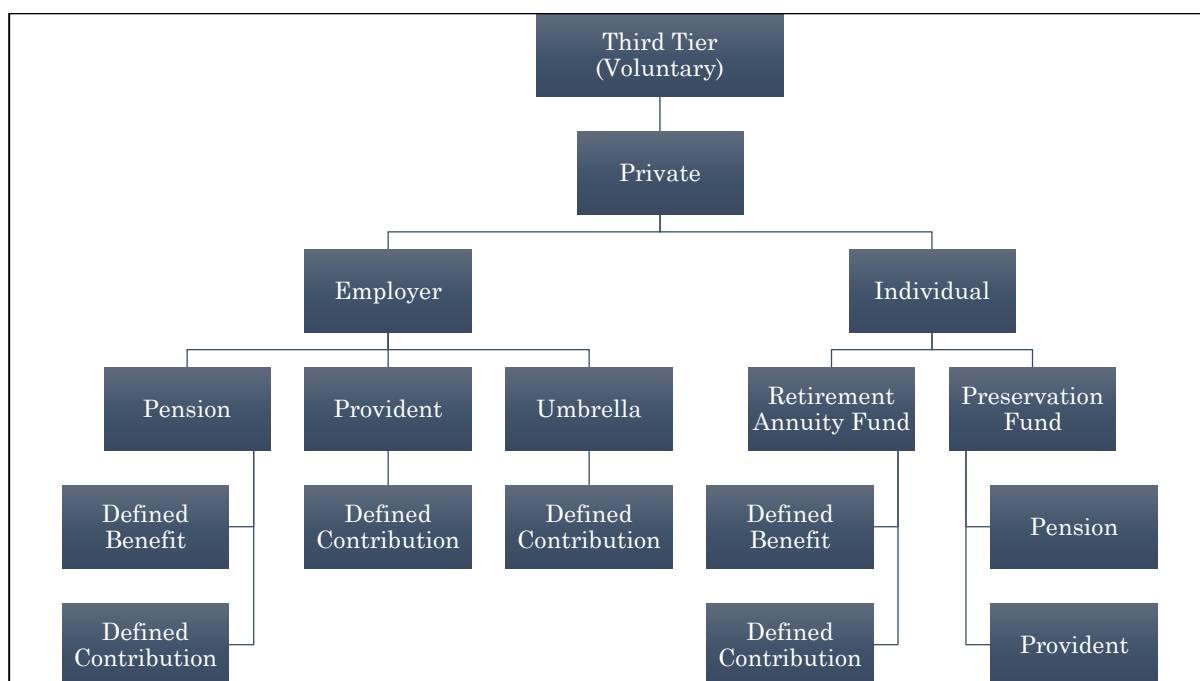


Figure 2.2: South African Retirement Fund Structures

Source: Constructed from Van Den Heever (2007:2)

2.1.1.2 South African Retirement Funds and Legislation - Employer

Employers in the private sector typically offer any one of the three different retirement funds to employees, as depicted in Figure 2.2. These include pension, provident, and umbrella funds.

These funds are described in the Income Tax Act No. 58 of 1962 (Republic of South Africa, 1962). This Act is one of two legislative bases which govern the South African retirement system (National Treasury, 2012a:8). The Act regulates pre- and post-retirement savings which include the different types of annuities offered. The second base, the Pension Fund Act No. 24 of 1956, stipulates the types of institutions which may offer retirement products as well as various regulations pertaining to management of retirement funds (Rudman, 2009:3).

Pension funds are generally subject to stricter regulations than provident funds, but National Treasury has indicated that a restructuring of provident funds is under way (National Treasury, 2012b:5).

The main distinction between pension and provident funds, apart from various tax regulations, is the application of subparagraph (*dd*) of paragraph (ii) of the proviso to paragraph (*c*) in Section 1 of the Income Tax Act No. 58 of 1962 (Republic of South Africa, 1962). This specific regulation, applicable to the definition of a pension fund, specifies that it is required by law for pension fund members to purchase an annuity with at least two-thirds of their accumulated pension capital at retirement. The other third is commutable in cash. There is, however, an exception to this rule. If the two-thirds value is below R150 000 the full amount may be commutable and no obligatory purchase of an annuity is required (National Treasury, 2012d:41).

Subparagraph (*dd*) mentioned above is not applicable to provident funds and subsequently the entire accumulated pension amount is payable as a lump sum to retiring individuals (De Villiers-Strijdom, 2013:4). This implies that individuals retiring from a provident fund could theoretically spend their entire pension savings as they please. This includes, for example, purchasing an annuity with all their accumulated provident fund capital, or settling all outstanding debt on a mortgage.

Pension funds can be structured either as DB or DC schemes while provident funds can only be structured as DC schemes. This is due to subparagraph (*dd*) not being enforced under provident fund regulation. DB schemes automatically use the accumulated capital to pay a guaranteed annuity to retirees and it would therefore not be feasible to construct a DB provident fund.

Umbrella funds, being the third fund usually offered by employers, are multi-employer retirement funds which imply that the employees of various employers belong to one fund

which is set up by a financial service provider. The employers belonging to the fund are usually small companies for whom it won't make economic sense to set up their own retirement fund. Retirement funds operate at an optimum level when there are enough members to achieve economies of scale, i.e. when variables such as fund charges and mortality risk can be spread across members (National Treasury, 2013b:12). Consider for example a DB fund: should such a fund consist of a large number of members, the plan can afford some of them outliving the average mortality projections because this will be offset by those that die prematurely. If, however, an opposite scenario should occur where the fund has few members with more pensioners outliving the average life expectancy and only few premature deaths, the fund will have to provide more retirees with a monthly income for an extended period of time (Beth & Fornia, 2008:6). Finally, these funds are structured on a pension or provident basis, but only operate under a DC scheme (Van Den Heever, 2007:3).

2.1.1.3 South African Retirement Funds and Legislation - Individual

Individual based retirement funds consist of retirement annuity and preservation funds, although preservation funds do not operate with the same mandate as retirement annuity funds.

Retirement annuity funds are offered by life assurance companies and require no employer/employee relationship. These funds provide self-employed individuals the opportunity to save for retirement, as well as individuals who wish to contribute to a retirement fund over and above their employer-based fund (Van Den Heever, 2007:3; Liberty Corporate, 2012:9). As with pension funds, subparagraph (*dd*), or the two-thirds rule, also applies to these funds. Furthermore, the underlying capital is not commutable before age 55 (Republic of South Africa, 1962).

Preservation funds provide the opportunity to individuals who are transferring from one employer to another to preserve their accumulated retirement capital. The capital is placed in either a pension or provident preservation fund as individuals will not contribute any further to their previous employer's retirement fund. In some instances it is, however, possible to transfer the accumulated capital to the new employer's retirement fund. These funds also allow one withdrawal of an unlimited amount prior to retirement (Van Den Heever, 2007:3; Liberty Corporate, 2012:10).

2.1.1.4 South African Retirement Funds and Legislation - Tax

Tax regulations surrounding retirement is a vast research field in itself and National Treasury revises legislation on a continual basis (Liberty Corporate, 2012:45). This section will therefore only provide an introduction to current tax legislation regarding retirement. It is important to note that retirement tax legislation is currently being revised along with many retirement regulations. The anticipated date for the new tax legislation to take effect is the 1st of March 2016 (Du Preez, 2015). It was initially set to be implemented on the 1st of March 2015, but this was postponed by a year due to opposition from labour unions (National Treasury, 2014b:5, Du Preez, 2015). The proposed tax reforms are discussed in Section 2.4.6.1.

This section is divided into the tax implications for individuals in the pre- and post-retirement stages of their lives, and also covers certain legislation applicable at retirement.

Table 2.1 presents a summary of pre-retirement tax treatment as is currently applicable to employed individuals and the employers themselves.

Table 2.1: Current Multiple Contribution Model

Source	% cap on deduction	Contribution Type – Base	Retirement Fund
Employer	Exempt entity – unlimited	<i>“approved remuneration”</i>	Pension or provident fund
	Taxable entity – usually between 10% & 20%		Pension or provident fund
Employee taxpayer with employer-affiliated fund	0%	No deduction available initially, but non-deductible contributions may be deducted prior to calculating tax upon exit from the fund.	Provident fund
	7.5%	<i>“retirement-funding employment”</i> -income. Non-deductible contributions (exceeding the annual caps) may be deducted prior to calculating tax upon exit from the fund.	Pension fund
	15%	<i>“non-retirement-funding employment income”</i> . Non-deductible contributions may be deducted in each consecutive year depending on whether the caps have been reached for that year.	Retirement annuity fund
Self-employed taxpayer or employee taxpayer with no employer-affiliated fund or earning additional income	15%	<i>“non-retirement-funding employment income”</i> . Non-deductible contributions may be deducted in each consecutive year depending on whether the caps have been reached for that year.	Retirement annuity fund

Source: National Treasury (2012d:9)

Employers contributing on behalf of their employees to an employer-affiliated retirement fund may claim a deduction, subject to a certain percentage cap, for tax purposes. A minimum deduction of 10% of *approved remuneration* is allowed. *Approved remuneration* is defined in Section 11 subparagraph (iii) of paragraph (l) of the Income Tax Act No. 58 of 1962. In short the term implies all employment income as well as other taxable employment benefits (National Treasury, 2012d:10; Retirement Fund Contribution, 2014). The South African Revenue Service (SARS), however, allows tax-deductible contribution rates of up to 20% of approved remuneration (Lester, 2013a:1).

Individuals are currently taxed, with regards to pre-retirement, according to the retirement fund to which they belong to. Employed workers contributing to a pension fund may deduct a total of 7.5% of their *retirement-funding employment-income* or R1 750 per annum (whichever is greatest) in the calculation of their annual taxable income. This regulation is as per Section 11 subparagraph (i) of paragraph (k) of the Income Tax Act No. 58 of 1962 (Republic of South Africa, 1962). In essence, individuals' *retirement-funding employment-income* is defined as their pensionable income earned (National Treasury, 2012d:10). Provident funds, on the contrary, do not allow for employee deductions.

Legislation concerning retirement annuity funds is stipulated in subparagraph (A) of paragraph (aa) of the proviso to paragraph (n) in Section 11 of the Income Tax Act No. 58 of 1962 (Republic of South Africa, 1962). Employees contributing to a retirement annuity fund may deduct the greater of three measures: R1 750 per annum, R3 500 of pension fund contributions, or up to 15% of their annual *non-retirement-funding employment income* in the calculation of their annual taxable income (Lester, 2013a:1; National Treasury, 2012d:10). *Non-retirement-funding employment income* in this case is defined as all income earned less pensionable income. These funds are specifically classified as non-employer, or individual funds, and subsequently all the contributions, be it from the employer or employee, are deemed to have been made by the employees themselves (Retirement Fund Contribution, 2014; National Treasury, 2012d:9).

At retirement two-thirds of the accumulated pension or retirement annuity fund capital has to be used to purchase an annuity, as was mentioned in Section 2.1.1.2. The other third is commutable in cash. This third is subject to income tax according to certain marginal rates as determined by National Treasury. As at the end of 2013 the first R315 000 was commutable as a tax-free amount whereafter marginal rates of 18%, 27%, and 36% applied, depending on

the amount commuted (National Treasury, 2014a:49; Lester, 2013a:5). On the 1st of March 2014 this amount increased to R500 000 and the marginal rates remained the same (SARS, 2015).

After retirement, individuals are taxed based on their annual income and their subsequent marginal tax rate. Tax relief in retirement is typically in the form of a lower marginal tax rate in retirement, as opposed to pre-retirement, due to income generally being lower in the retirement phase of an individual's life (Cameron, 2014a). This implies less tax being paid per Rand earned. Furthermore, no Capital Gains Tax or Dividend Withholding Tax is payable on the investment growth earned on savings in a retirement fund. Finally, individuals over the age of 65 who are contributing to a medical scheme are also entitled to certain tax deductions (Cameron, 2014a).

2.2 South African Annuity Options

As mentioned before, a South African retiree that saved for retirement through a pension or retirement annuity fund is obligated to purchase an annuity with two-thirds of the underlying capital at retirement. Currently, there are two types of annuities offered in South Africa, namely conventional and living annuities. This section explains the structure of each annuity and concludes with an overview of annuities offered outside South Africa. Figure 2.3 is presented as a graphical illustration of the annuity options in South Africa.

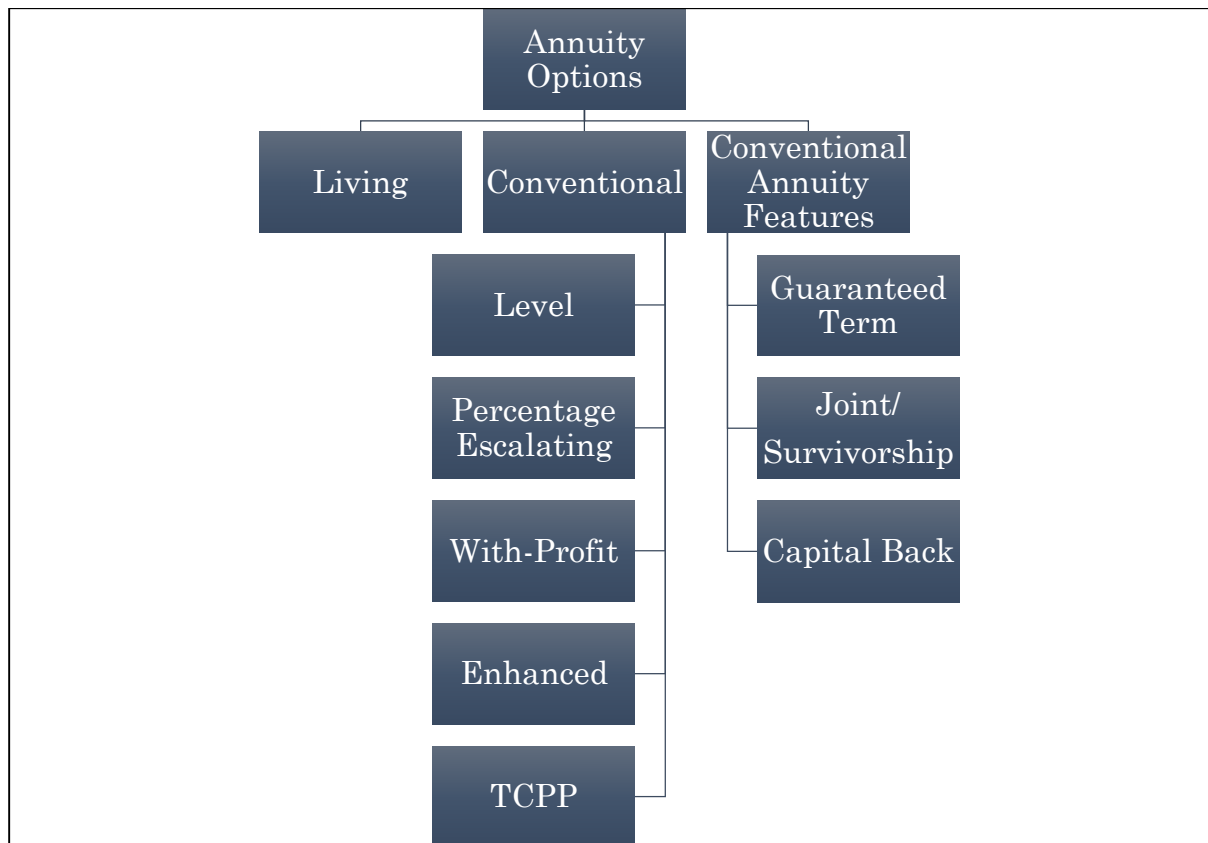


Figure 2.3: Annuity Options in South Africa

Source: Constructed from Retirement income plans (2012)

2.2.1 Conventional Annuities

Conventional annuities, also known as life or guaranteed annuities, provide a guaranteed income for the life of the annuitant. Effectively, it is a contract binding the life insurer (the annuity underwriter) with the insured (the annuitant). In exchange for an initial non-refundable upfront premium, the life insurer guarantees a periodical payment to the insured. The term ‘non-refundable’ includes that no capital will be paid to any relatives or dependants at the death of the annuitant.

This leads to the question of how a life company can *guarantee* an annuity. Companies offering these products are profit-driven organisations and subsequently do not just provide a public service. By offering the guaranteed payment, the company implicitly assumes both the investment and mortality risk (Goemans & Ncube, 2008:2). This is similar to a DB pension fund. The answers to the questions lie in pooling all the annuity premiums together and

profiting on the mortality experience of the underlying annuity holders, as well as providing for an investment margin.

Lodhia and Swanepoel (2012:123) state that life companies price the annuities by including the mortality projection of the entire pool, not just per individual. A life company thus stands to profit if the expected average life expectancy of the pool is higher than the actual mortality experience. If for example the actual average mortality is 25 years and the life company priced annuities based on an average projected mortality of 30 years, the average initial premiums paid by the annuitants will be higher than the total average of benefits paid out by the company, *ceteris paribus*.

The argument can be made as to why a life company does not simply price annuities according to high life expectancy projections. The reason for this is that the annuity market is very competitive and therefore keeps annuity pricing fair (Rusconi, 2008:26; Lodhia & Swanepoel, 2012:124).

The annuities paid to annuitants are determined through actuarial computations. In general, there are three inputs to the pricing model used in determining the level of income an annuitant will receive (Goemans & Ncube, 2008:19).

The first input is the current structure and level of the yield curve. The underlying investments of conventional annuities are heavily weighted towards bonds (Retirement income plans, 2012; Stanlib, 2012:10). Thus, if current market interest rates are high, the subsequent payment from an annuity will also be high. There is a direct relationship between interest rates and the annuity paid. Once the annuity amount has been established, it will not be adjusted to reflect future interest rate movements (Nienaber & Reinecke, 2009 as cited by De Villiers-Strijdom, 2013:7).

Projected mortality, being the second factor which influences the level of the annuity offered, includes the age and gender of an individual. On a historic basis, females have a longer life expectancy than males (Life expectancy, 2013:2). There is an inverse relationship between the annuity paid and life expectancy, i.e. the longer a retiree is expected to live, the lower the annuity will be (Cameron, 2014b).

The third factor is an allowance for the life company's expenses and profits. Companies implicitly charge annuity holders via the annuity they receive by deducting their expenses,

typically as a percentage of the premium, from the premium paid (Goemans & Ncube, 2008:19).

A final noteworthy regulation is that once a conventional annuity has been purchased, the action may not be reversed (Retirement income plans, 2012).

In practice there are three conventional annuity products offered to retirees, namely level, percentage escalating, and with-profit annuities. A fourth product also exists but is only offered by Sanlam, a South African life insurance company. It is important to remember that these three products each contain a guaranteed element in their structure.

2.2.1.1 Level

Level annuities are the most popular products purchased by retirees opting for conventional annuities (National Treasury, 2012a:26). These products pay a level annuity for the life of the annuitant and are the most simplistic form of a conventional annuity. Due to its simplicity, this annuity also pays the highest initial annuity of all. It is believed that this has a great behavioural influence on the actual purchase decision of the retiree. There is a short-sightedness by retirees in that they do not realise the impact inflation will have in the long-term. The annuity initially looks attractive, but with time reduces in purchasing power (Cameron, 2014b).

2.2.1.2 Percentage Escalating

Percentage escalating annuities pay an initial annuity which will increase by a specific percentage per year. These escalations can also be linked to inflation from which the term inflation-linked annuities arose. These annuities pay a lower initial annuity in comparison with level annuities due to their increasing component. It is rather intuitive that the initial benefit receivable would decrease should more guarantees be added to an annuity. The underwriter has to somehow compensate for the added risk it assumes when guaranteeing to increase a certain payment at regular intervals (Retirement income plans, 2012).

2.2.1.3 Enhanced

Enhanced annuities pay a higher benefit to individuals who can prove that they may have a shorter-than-average life expectancy due to ill health or because of an unhealthy lifestyle. Underwriters deem such individuals to be of 'lower risk' to them in that the benefits payable to these individuals should be of shorter duration (Retirement income plans, 2012).

2.2.1.4 With-Profit

With-profit annuities are structured to share similar characteristics with both conventional (percentage escalating) and living annuities (explained in Section 2.2.3).

As with the level and percentage escalating annuities, the annuitant receives a guaranteed periodic payment from the insurer in exchange for an initial non-refundable upfront premium. The difference, however, is the extent of the guarantee and the percentage escalation.

From a conventional perspective the with-profit annuity is only partially guaranteed in the sense that the future annuity paid by the insurer may never be below that of the current annuity paid in nominal terms. From a living annuity perspective the annuitant is exposed to a certain degree of equity investments. The equity exposure provides for the increasing component, or percentage escalation, of the with-profit annuity. In essence a with-profit annuitant will receive a periodic annuity, guaranteed to be at least the same as the Rand amount of the current annuity, and the periodic increase is subject to market returns (Cameron, 2014b).

This increasing component, called the bonus rate, is linked to the performance of the underlying with-profit investment fund which is managed by the life insurer (Cameron, 2012). This differs from the increasing component of a conventional annuity in that the increase in the conventional annuity is guaranteed by means of underlying bond investments (Retirement income plans, 2012; Stanlib, 2012:10). The with-profit annuity bonus rate is thus subject to equity market returns and cannot be a guaranteed fixed percentage. For all intents and purposes the rate could be zero percent but never negative (Goemans & Ncube, 2008:25). Each increase in the annuity raises the guaranteed payment to a new level in that subsequent annuities may never be lower than the previous escalated annuity.

Annuitants are allowed a certain level of discretion in the determination of their future bonus rates as well as the initial pension. Formula 2.1 depicts a simplified methodology of the bonus rate determination (Cameron, 2014b):

$$\text{Bonus Rate} = I - C_E - C_I - PRI \pm MP \quad (\text{Formula 2.1})$$

with:

$I = \text{Investment return on portfolio}$

$C_E = \text{Explicit costs}$

$C_I = \text{Implicit costs}$

$PRI = \text{Post retirement rate of interest}$

$MP = \text{Mortality profits}$

From Formula 2.1 it is clear that the bonus rate is a function of investment returns less explicit and implicit costs, less the post retirement rate of interest (PRI), plus (minus) any mortality profits (losses).

The underlying with-profit investment portfolio is used to pay the guaranteed and increasing amounts. Therefore this portfolio has to have an asset allocation which is neither too conservative nor aggressive. An aggressive portfolio, i.e. more funds allocated to equity investments, will expose the insurer to the risk of not being able to meet the guaranteed payment. However, not having a sufficient risk exposure will lead to low bonus payments and eventually to lower product sales (Goemans & Ncube, 2008:26).

Explicit costs are fees levied by the insurer which cover their management costs of the product as well as a fee for the guarantee of the pension being offered. Implicit costs are embedded in the annuity and are typically in the form of investment guarantees, smoothing rates, and funding levels (Cameron, 2014b).

Bonus rates are smoothed which imply that out-performance from the underlying fund is not paid out in full so as to compensate for future years in which investment returns will underperform. This is deemed an implicit cost as the money from out-performing years could have been paid out to the annuitant, but is held back (Cameron, 2014b). Funding levels can also be regarded as an implicit cost. Retirees purchasing a with-profit annuity are effectively buying

into an investment fund which includes all the investments of current with-profit annuitants. This fund may, however, be underfunded in the sense that liabilities may be greater than current assets and new entrants to the fund will inadvertently be funding the deficit (Cameron, 2014b). If the with-profit pool has an underfunded ratio that is worse than 92.5% it is required as per the Long-Term Insurance Act No. 52 of 1998 that the assurer must disclose this underfunded status (Republic of South Africa, 1998; Cameron, 2014b).

With-profit annuitants are allowed to choose their PRI subject to certain limitations. This rate represents a minimum return guaranteed by the insurer. The PRI not only influences future bonus rates, but also the initial annuity level. A higher PRI will decrease future bonus rates as can be seen from Formula 2.1, but will offer a higher initial annuity (Cameron, 2014b).

Finally, mortality profits are linked to mortality risk as explained in Section 2.1. If more pensioners die earlier than was expected by the life company, then additional ‘profits’ will arise (Cameron, 2014b).

2.2.1.5 The Complete Picture Pension

The Complete Picture Pension (TCPP) annuity offered by Sanlam is the first of its kind. The TCPP annuity operates in a similar way as the with-profit annuity but with one main difference. With-profit annuities have been criticised for not being transparent in the calculation of their annuity increases. It is this shortcoming that the TCPP annuity seeks to address. The annuity guarantees annuitants an increase in their yearly annuity according to the transparent Formula 2.2.

This formula calculates the geometric average of the last five years’ returns of a portfolio comprising of 50% of the JSE Top 40 Total Return Index and 50% of the ALBI. The increase is subject to a minimum of 0% (TCPP, 2014).

$$Increase = Max \left\{ \frac{[(1+i_1)(1+i_2)(1+i_3)(1+i_4)(1+i_5)]^{\frac{1}{5}}}{1+PRI} (1 - 0.025) - 1; 0 \right\} \quad (Formula 2.2)$$

with:

$$i_n = (0.5Return_{Top40} + 0.5Return_{ALBI})$$

$$PRI = 3.5\%$$

For a new annuitant the TCPP annuity assumes that the first four preceding years' returns (i_1 to i_4) are equal to 11% each. The fifth year's returns are actual market returns. After inception of the policy the preceding years' returns are filtered out and the actual market returns replace the assumed 11%. The PRI is equal to 3.5% and a fixed fee of 2.5% is levied on the annual increases. This consists of administration, trading cost such as taxes, and guarantees.

The annuity thus provides all the benefits of the with-profit annuity and eliminates most of the disadvantages. The income is guaranteed and the increase is subject to market returns. The annuitant, however, can see how the increase is determined and has the assurance that future annuities payable will never decrease in nominal terms.

2.2.2 Added Annuity Features

Conventional annuities can be bought with various options so as to satisfy annuitants' diverse needs. There are three general options available to retirees: guaranteed term, joint-life, and capital back (Retirement income plans, 2012). All three available options are structured to overcome the main drawback of conventional annuities, i.e. the non-refundable initial premium payable to the insurer. This implies that anyone who is financially dependent on the income the annuity provides, other than the main annuitant, will have no income at the death of the annuitant as all payments end with the death of the annuitant. It is important to note that any feature added to a conventional annuity will decrease the annuity receivable by the annuitant. This is because the insurer assumes more risk in structuring an annuity with any one of these options added (Retirement income plans, 2012).

2.2.2.1 Guaranteed Term

A guaranteed term allows for the continuous payment of the annuity to a stipulated beneficiary after the death of the annuitant. The same Rand amount will be paid as was payable during the life of the annuitant. The annuity will cease payment after the specified term has lapsed. For example, if an annuity with a guaranteed term of ten years is purchased and the main annuitant dies five years into the contract, the annuity will continue its payments

to the beneficiary for another five years. Should the annuitant die after the ten-year period no payment will be made to the beneficiary (Retirement income plans, 2012).

2.2.2.2 Joint-life/Survivorship

Joint-life annuities are structured specifically for spousal couples. The annuity pays a certain percentage of the original annuity to the last-surviving party for the remainder of that party's life (Retirement income plans, 2012).

2.2.2.3 Capital Back

Capital-back annuities return the initial capital investment to nominated beneficiaries or to the deceased annuitant's estate. Part of the monthly annuity payment is used to pay a life assurance premium – this guarantees that the capital can be repaid at the annuitant's death. This can be an expensive option in that the life assurance premium is deducted from the periodic annuity (Retirement income plans, 2012).

2.2.3 Living Annuities

Living annuities, being the second type of annuity sold to the South African public, differ substantially from conventional annuities.

When this annuity is purchased, the premium paid to the insurer is invested in specific asset classes according to the annuitant's preferences. A drawdown from the underlying investment fund, rather than an actuarially determined annuity, is then made by the living annuitant. An annual permissible drawdown range between 2.5% and 17.5% of the underlying fund value at the start of the year is currently allowed. This 'annuity' is deducted from the fund along with the associated management fees and the fund then grows or declines in value according to the performance of the underlying assets (Goemans & Ncube, 2008:3). It is important to note that these annuity payments are not guaranteed as they are subject to market performance (Retirement income plans, 2012).

Perhaps the most distinctive feature is that the underlying fund value may be bequeathed to nominated beneficiaries at the death of the annuitant. The popularity of these products in South Africa has escalated to such an extent that various researchers have attempted to establish a reason for the popularity. It is thought that living annuitants do not have adequate financial literacy to understand the product structure and the incentive scheme to selling these products is biased toward high commissions. Therefore, it is believed that many pensioners purchase these products without understanding the full extent of their exposure and are thus exposed to a high level of longevity risk, i.e. outliving their retirement capital (National Treasury, 2012a:21).

According to Botha, Du Preez, Geach, Goodall and Rossini (2014:960), Directive 135 and 135A to the Long-Term Insurance Act No. 52 of 1998 provides annuitants with the ability to transfer their living annuity policy from their current long-term insurer or retirement fund to any other long-term insurer. These directives also provide the opportunity to convert a living annuity to a conventional annuity at any stage. Once this option has been executed, it is not reversible.

2.3 Annuities: An International Comparison

South Africa has a very unique, but well developed financial services sector (ASISA, 2013:1). It is argued that South Africa's financial services sector, with specific reference to annuity providers, could benefit from investigating and analysing the annuity markets of other developing as well as developed countries. For instance, the United Kingdom has the oldest annuity market and could potentially provide valuable information with regards to future annuity developments in South Africa (Blake & Turner, 2013:1). This is especially true since National Treasury is contemplating the introduction of a default annuity product (National Treasury, 2012a:37). It is thus believed that *all* options, even those outside South Africa, should be considered for such a purpose. This section provides a brief overview of the retirement income systems of four other countries as well as the annuities offered in those countries.

2.3.1 Australia

The retirement income system of Australia consists of three components: a broader means-tested old age grant, a superannuation guarantee, and voluntary private savings (OECD, 2013:211; Social security, 2014). The overall structure is very liberal in that it provides great freedom to retirees with regards to the utilisation of their accumulated retirement capital (Rocha, Vittas & Rudolph, 2010:13).

The superannuation features are similar to the DC pension funds offered in South Africa. At retirement, a retiree has three options. Firstly, the underlying capital is commutable as a lump sum. Secondly, the superfund may be accessed by means of a regular income drawdown. And thirdly, an annuity may be purchased with the underlying capital (Income from super, 2014).

According to Cannon and Tonks (2010:99) the Australian annuity market is poorly developed. Despite this, the annuities offered in Australia are structured in a very similar fashion to that of South African annuities. Currently there are two main types of annuities offered in Australia, namely allocated (account based and market linked) and life (fixed term and lifetime) annuities. Figure 2.4 presents a graphical illustration of the annuities offered in Australia as well as the additional features that may be added to these annuities.

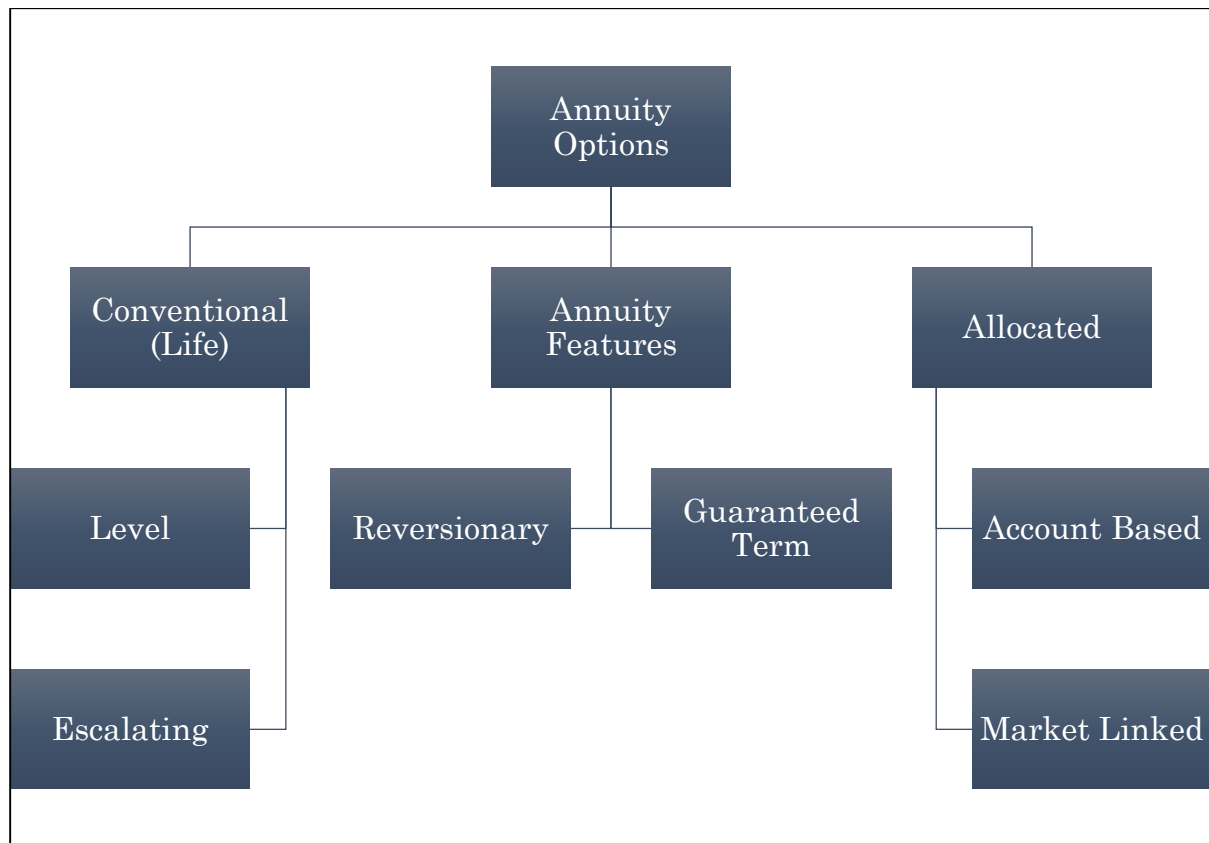


Figure 2.4: Australian Annuity Options

Source: Constructed from (Brunner & Thorburn, 2008:17)

Account based allocated annuities are closely related to South African living annuities. Annuitants are allowed to choose their investment strategy and only minimum drawdown rates are enforced. These rates are based on the annuitant's age and range from 4% to 14%. Furthermore, annuitants have full access to the underlying capital at any given time (Rocha, *et al.*, 2010:20; Retirement Income Streams, 2012).

A variation of the account based allocated annuity is the market linked allocated annuity. Underwriters of these annuities are required, by law, to provide an income stream for a fixed term. The duration of the fixed term is chosen by the annuitant and is subject to a minimum and maximum limit as well as to the annuitant's life expectancy as at the purchase date of the annuity. The minimum term must be equal to the annuitant's rounded life expectancy. The maximum term must equal the difference between 100 and the annuitant's age on the date of purchase. The payment from these annuities is then calculated by dividing the account balance (or initial premium) by a factor applicable to the remaining term. This calculation

yields an amount which may be adjusted by 10% either way according to the annuitant's preferences. This process is repeated annually in determining the benefit paid by the annuity (Brunner & Thorburn, 2008:17; Retirement Income Streams, 2012).

These annuities also differ from allocated account based annuities in the sense that they are substantially less flexible when it comes to accessing the underlying capital. In general they are structured as non-commutable products. The underlying capital is, however, payable to beneficiaries at the death of the annuitant as is allowed under allocated account based annuities (Brunner & Thorburn, 2008:17; Retirement Income Streams, 2012).

Australian conventional (guaranteed) annuities have various forms and options and are similar to those offered by South African guaranteed annuities. Although the terminology differs, the general concepts and product structures are the same. Lifetime annuities, which consist of level and escalating (both percentage and inflation-linked annuities), pay a guaranteed income to the annuitant regardless of their age and the following garnishing options are available from which to choose so as to provide for the diverse needs of annuitants (Brunner & Thorburn, 2008:18; Retirement Income Streams, 2012):

- Reversionary: at the death of the annuitant a specific proportion of the original annuity is paid to the surviving spouse.
- Guarantee terms: this option pays a guaranteed income for a specified term even after the death of the main annuitant. The most common guaranteed term elected by annuitants is ten years. Should the reversionary option also have been elected, a guarantee period longer than that of the beneficiary's or spouse's life expectancy may be selected, but it may not be greater than 20 years.

2.3.2 United Kingdom (U.K.)

As a protective measure against old age poverty, the U.K. provides a basic pension to all pensioners which is subsidised by government. Currently there are two tiers to this public scheme – the flat-rate basic pension and an earnings-related additional pension (OECD, 2013:357).

The earnings-related additional pension, or State Second Pension as it is known, is paid on top of the basic pension to individuals who suffer from illness or disability or who have specific

caring duties such as caring for sick or disabled people. The total amount receivable depends on an individual's earnings and the number of years the individual has contributed to the National Insurance programme (U.K. Pensions, 2014a). Citizens in the U.K. contribute to the National Insurance programme which builds up their entitlement to certain state benefits, including the State and State Second Pension (U.K. Pensions, 2014b).

This two-tier system is set to be replaced with a single tier system by April 2016. This change in the retirement income system has been brought about mainly due to the complexity of the current system. It is thought that pensioners will have less of a financial decision making burden with the introduction of a simpler single-tier system (U.K. Pensions, 2014c).

Apart from this public scheme employees also contribute to employers' pension funds, structured either as DB or DC schemes. At retirement, DC pension fund members have four options of accessing their pension capital. First, the full pension amount may be withdrawn, but this option is heavily penalised by means of a 55% tax rate being levied upon withdrawal. Retirees are, however, allowed to take 25% of the pension capital as a tax free amount at retirement. Second, the retiree may purchase an annuity. Third, retirees have the option to draw down their capital systematically – often referred to as an income drawdown account (Munnell, 2014). Pensioners may draw any amount of their pension capital they wish, but are subject to a drawdown cap should they not have a guaranteed annual pension income from any other source equal to at least £12 000. The cap is equal to 150% of an annuity as determined by the Government Actuary's Department (Thurley, 2014:29). Finally, the fourth option available to retirees is called phased retirement.

This fourth option is similar to the income drawdown strategy. However, the benefit paid from this strategy is in the form of an annuity as opposed to a direct drawdown from the pension account. Scheduled withdrawals are made over several years and with each withdrawal an annuity is bought. This is achieved by splitting the pension fund into many separate segments. These different segments allow individuals to utilise part of their pension to provide them with an income for the year while investing the remaining segments in investment funds of their choice. The majority of income will thus come from tax-free cash in the early years, but with time the annuities purchased each year accumulate to represent a greater part of the total income received (Cannon & Tonks, 2010:26; The Annuity Bureau, 2014:3).

It should be noted that U.K. citizens are only allowed to access their retirement savings at the age of 55 (Thurley, 2014:29).

As with South Africa, the U.K. retirement system is also undergoing significant reforms. From April 2015 the caps on drawdown accounts have been abolished. Furthermore, future retirees are also able to take any amount of their pension savings at retirement without being subject to the 55% tax rate, but will rather only be taxed at their marginal income tax rate (Munnell, 2014).

The U.K. is at the forefront of annuity product variation in comparison with global peers (Rusconi, 2008:6). The annuities offered are similar to the options available in South Africa, but other unique products also exist. Figure 2.5 presents the different annuities and various additional features available from which to choose.

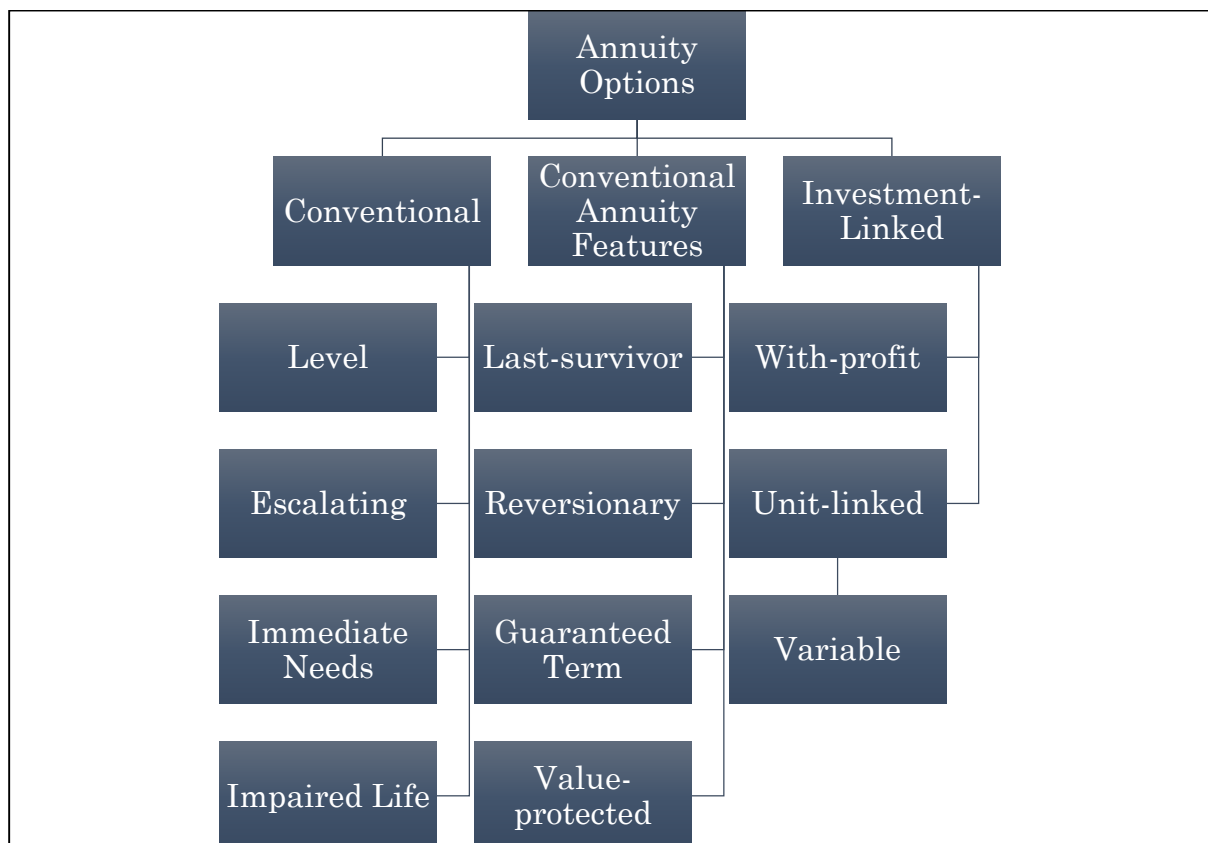


Figure 2.5: U.K. Annuity Options

Source: Constructed from Cannon and Tonks (2010:20)

Level, impaired (enhanced) life and escalating annuities are all structured in similar fashion to their South African peers. An immediate needs annuity is provided to elderly individuals who are in need of being admitted to a nursing home. As with impaired annuities, immediate needs annuities offer enhanced rates due to the annuitant's lower life expectancy. The benefit is paid gross of tax to the nursing home, and provides greater tax benefits than an impaired life annuity (Cannon & Tonks, 2010:26).

The annuity features offered in the U.K. are also similar to those offered in South Africa. Value-protected annuities will return a certain percentage of the initial capital investment at the death of the annuitant. Last-survivor annuities pay a benefit to both the main annuitant and a specified partner until both parties have passed away. The reversionary option, as with Australian annuities, will continue to pay a specific percentage of the original annuity to the surviving spouse after the death of the main annuitant (Cannon & Tonks, 2010:24).

Investment-linked annuities, similar to South African living annuities, allow for the underlying investments to include equity exposure. These annuities are structured either as with-profit or unit-linked. The with-profit annuity operates in similar fashion to the South African product. The product thus offers a guarantee to a certain extent and pays out bonuses which are subject to the performance of the annuity provider's with-profit investment fund. Unit-linked annuities, on the other hand, pay benefits which are related solely to the value of the underlying investment portfolio (Cannon & Tonks, 2010:25).

Finally, variable annuities are unit-linked investment annuities and offer additional features. These features include options such as the annuity providing a guaranteed income for a temporary period, at the end of which a level annuity can be purchased with the remaining funds. Other options also exist such as purchasing a variable annuity with a last-survivor option attached. This would allow the annuitant to revert to a single annuity after the spouse's death (Cannon & Tonks, 2010:25).

2.3.3 United States of America (U.S.)

As per the classification of retirement income systems in Figure 2.1, the U.S. system consists of a mandatory first tier, and voluntary second and third tiers. The first tier is similar to that of the U.K. in that it provides pensioners with a public pension benefit, known as social security.

A means-tested supplementary benefit also exists for low-income elderly, disabled, or blind pensioners (OECD, 2013:362; Forman & Mackenzie, 2013:10).

The Old-Age and Survivors Insurance, the formal term for social security, provides monthly cash benefits to retired individuals and their dependants. Eligibility for these public retirement benefits is subject to the number of years an individual has worked in employment covered by the social security programme. Retirees older than 62 that have worked in covered employment for a minimum of ten years are entitled to receive the retirement benefits. The level of benefits receivable is structured in such a way as to benefit individuals with lower lifetime earnings (Forman & Mackenzie, 2013:5).

The second tier, being voluntary in nature, does not require employers to offer pensions. Employers that do, typically offer a DC scheme that encompasses a variety of different plan options from which the employer may choose in structuring the pension fund. Included in these plan options are: money purchase pension, target benefit, profit-sharing, employee stock ownership, and stock bonus plans. Each of these options comprises of different regulations, contribution limits, tax advantages, and vesting rules which leads to substantial complexity in the operation of these schemes (Forman & Mackenzie, 2013:28).

Of these plans the profit-sharing and stock bonus plans are most common. In accordance with the Internal Revenue Code section 401(k) a feature is included in these two plans which allows employees to defer receiving a portion of their pre-tax salary which is contributed on their behalf to a retirement account. From this the generalised term ‘401(k)-plans’ arose. This particular plan requires employees to make a substantial number of choices such as the amount and timing of contributions, which underlying investments to invest in, and the timing and nature of distributions (Forman & Mackenzie, 2013:2,15).

One of the forms of distribution is through annuities. The U.S. annuity market is poorly developed in comparison with other countries, largely due to the coverage of the social security programme, but also because of the complexity and voluntary nature of U.S. pension plans (Forman & Mackenzie, 2013:14,49).

Two types of annuities, namely deferred and immediate annuities, are offered in the U.S. and each has its own respective options. Figure 2.6 depicts the annuity options offered in the U.S.

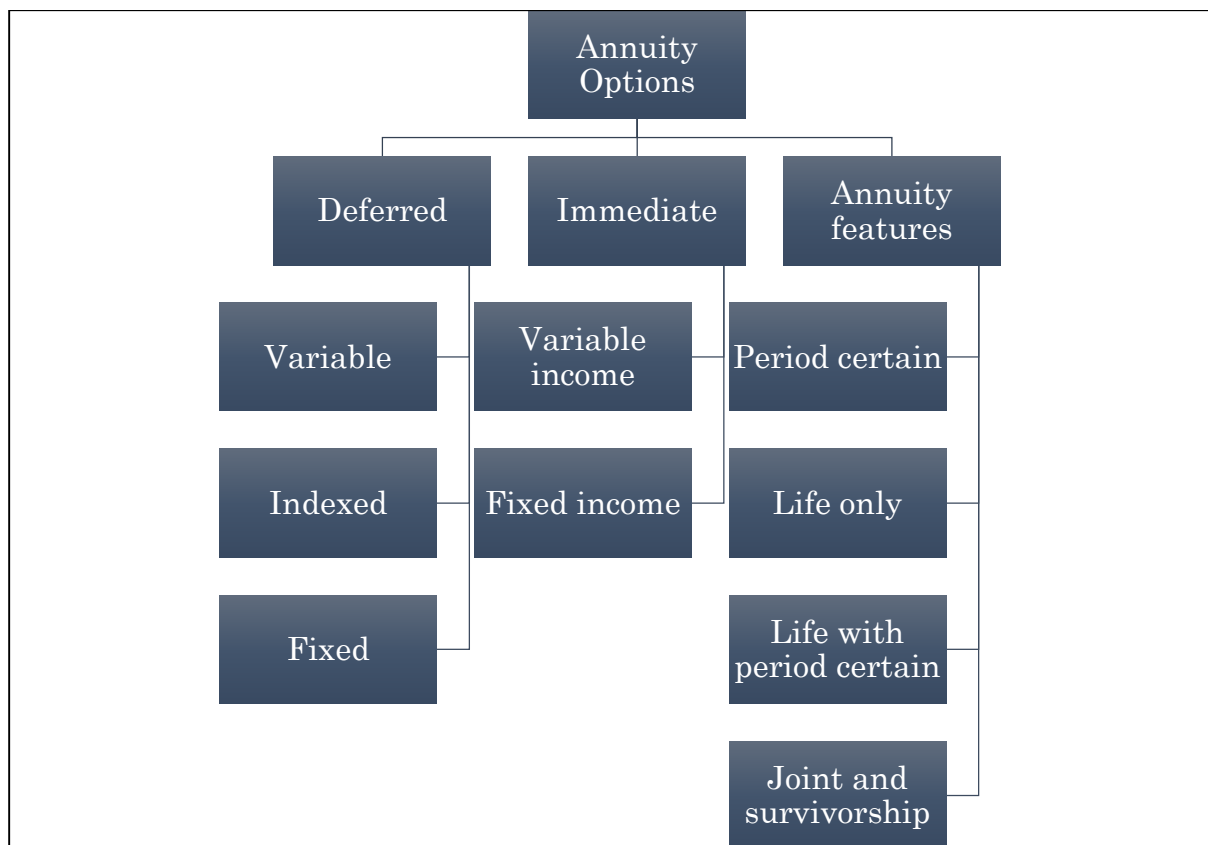


Figure 2.6: U.S. Annuity Options

Source: Constructed from Morgan Stanley (2013:3)

Immediate annuities, which are the more simplistic of the two products, are purchased with a single lump sum payment and start paying benefits within the year of purchase. Two sub-annuity options exist under the immediate annuity: a variable income and fixed income annuity (Morgan Stanley, 2013:2,3).

A variable income annuity provides a certain extent of equity exposure through mutual funds and is marketed to retirees who are willing to assume a certain degree of risk. The benefits paid by this annuity will, as the name suggests, fluctuate with the performance of the underlying assets (Morgan Stanley, 2013:3). Various types of guarantees, called living benefits, can be purchased which will prevent either the benefit receivable or the underlying capital from falling below a certain amount. These are elaborated on shortly. Variable income annuities also provide a death benefit which ensures that a nominated beneficiary will receive, upon the death of the main annuitant, the greater of all the money in the annuitant's account, or some guaranteed minimum such as all purchase payments adjusted for prior withdrawals

(SEC, 2014). Fixed income annuities, in contrast to variable income annuities, provide a stable income for life (Morgan Stanley, 2013:5; Pacheco, 2014a).

Deferred annuities consist of two phases: an accumulation and distribution phase. During the accumulation phase an individual's contributions will be tax deferred up until the distribution phase. Access to the underlying capital before the age of 59 ½ is subject to a 10% tax penalty (Morgan Stanley, 2013:2). These annuities can thus be seen as similar to the South African setup in terms of which an individual accumulates retirement capital in a DC fund and purchases an annuity at a later stage.

A deferred fixed annuity delivers a fixed rate of return during the accumulation phase for a certain period of time whereafter the rate may change depending on market interest rates. A minimum rate is, however, guaranteed below which the rate of return will never fall (Morgan Stanley, 2013:3). The distribution phase of the annuity comes in three forms (Pacheco, 2014b): a lump sum withdrawal, systematic withdrawal, and annuitisation. With the annuitisation option the annuity provider guarantees lifelong benefit payments to the annuitant.

Deferred indexed annuities provide a guaranteed minimum accumulation value and track a specific index such as the S&P 500 during the accumulation phase. The distribution options are the same as with deferred fixed annuities (Morgan Stanley, 2013:3; Pacheco, 2014b).

The accumulation phase of deferred variable annuities provides annuitants with the opportunity to invest in stocks and bonds. Again, the distribution options are the same as with deferred fixed annuities. The portfolio value at the end of the accumulation phase, as well as the benefits receivable during the distribution phase if the annuitisation option is selected, are subsequently determined by the performance of the underlying assets (Pacheco, 2014b; Lapierre, 2003:4). As with immediate variable income annuities, deferred variable annuities offer living and death benefit guarantees (Morgan Stanley, 2013:3). Living benefits include four different types (Haefeli, 2013:12): Guaranteed Minimum Accumulation Benefit (GMAB), Guaranteed Minimum Income Benefit (GMIB), Guaranteed Minimum Withdrawal Benefit (GMWB), and Guaranteed Minimum Death Benefit (GMDB).

The GMAB offers the annuitant a guarantee of the underlying capital. Irrespective of market returns, if the underlying annuity capital is below the guaranteed amount at a specific time, the insurer will provide the shortfall. A GMIB guarantees a minimum lifetime income stream

regardless of market movements. This option implies that the deferred variable annuity account must be annuitised. The third option, the GMWB, enables the annuitant to withdraw, for a specified number of years, a specified percentage of a notional amount used to determine the amount of payments to the annuitant from guarantees. A variation of this is the Guaranteed Lifetime Withdrawal Benefit (GLWB) which allows withdrawals for the remainder of the annuitant's life. The final option, the GMDB, guarantees a minimum lump sum payout at the annuitant's death (Haefeli, 2013:12).

A final feature of the U.S. annuity market is the garnishing options which are purchasable. These options include period certain, life only, life with period certain, and joint and survivorship annuities. The annuity options are structured in similar fashion to South African annuity options. A period certain option provides a guaranteed annuity for a specified time. Life only options pay a guaranteed income for life. Life with period certain options provide a guaranteed benefit for a specified time, and if the annuitant passes away in that time the benefit will be payable to nominated beneficiaries. Finally, a joint and survivorship option provides a guaranteed income to couples as long as either is alive (Morgan Stanley, 2013:4).

2.3.4 Nigeria

Nigeria's retirement income system is included in this discussion so as to provide an overview of the retirement markets of other developing countries with specific reference to the annuity products offered in these countries. Also, Nigeria surpassed South Africa as Africa's largest economy, based on Gross Domestic Product, early in 2014 and for this reason it is deemed a noteworthy country (Magnowski, 2014).

The Nigerian retirement income system underwent significant reform in 2004 when government made a decision in favour of DC schemes. It was decided that both the private and public sectors of the economy would provide DC pension funds only (Ibiwoye, 2008:176).

According to Section 1(2) of the Pension Reform Act No. 2 of 2004 all federal civil servants, military, police, and private sector employees in corporations with five or more employees are obligated to contribute to a retirement savings account (Republic of Nigeria, 2004; Casey & Dostal, 2008:248).

Section 3(1) of the Act states that individuals are not allowed access to their retirement savings before the age of 50. Three options exist which allow an individual access to the fund after age 50 or upon retirement. These three options are as per Section 4(1) of the Act (Republic of Nigeria, 2004):

- 1) Programmed monthly or quarterly withdrawals which are calculated on the basis of an individual's life expectancy.
- 2) Purchase of a life annuity from a life insurance company licensed by the National Insurance Commission with monthly or quarterly payments.
- 3) Withdrawal of a lump sum. This option is only available provided that the amount net of the withdrawal is sufficient to acquire an annuity, or fund programmed withdrawals, that will produce an amount not less than 50% of an individual's annual remuneration as at the date of retirement.

Based on the information that could be obtained from Mansard Insurance, a Nigerian insurance company, only a conventional life annuity is offered in this country. Three annuity features do, however, exist which make for more personalised annuity products. The first option is a guaranteed term of five or ten years. This option does not operate in the same manner as the guarantee term options of other countries explained in previous sections. The option will, upon the death of the annuitant, pay the present value of all future benefits receivable given the specified term to the deceased's beneficiaries. The second option, a spouse's annuity, provides a lifelong income to the spouse of a deceased annuitant. Generally, 75% of the amount originally paid to the main annuitant will be received by the surviving spouse. Finally, a life annuity can also have a whole-life option which pays 30%, 50%, or 70% of the original purchase amount to the main annuitant's beneficiaries upon his/her death (Mansard, 2014).

2.4 Retirement Industry Reform

The reform of the South African retirement industry has long been underway (Gluckman, 2010:137). These reforms should not be seen as a once-off occurrence, but rather as a

perpetual process. Government has deemed it necessary to reform the industry so as to increase the financial security of all citizens (National Treasury, 2012a:3).

National Treasury has since 2012 presented five papers, each with a different theme, that relate to retirement reform. These themes ranged from taxes, fees, annuity comparisons, and retirement capital preservation. The papers and proposed reforms contained in the papers have been publicly debated by stakeholders and certain policies have already been implemented. Others have followed over the course of 2014 and 2015 and more will follow over the long-term (National Treasury, 2014b:9).

In order for this study to contain timely and accurate information, these papers and proposed reforms are discussed in this section. It should be noted that the sections below are not summaries of the papers, nor are the proposed regulatory reforms presented here guaranteed to be implemented. Rather, selective information is presented from these papers that pertain to the topics covered in Sections 2.1 and 2.2. It was deemed appropriate to include this section in the study as the future of the South African retirement industry is uncertain – as is evident from the various reform debates and papers. The response of the Association of Savings and Investments South Africa (ASISA) to these papers was used as a proxy for stakeholders' comments and suggestions, and is briefly discussed after each paper. According to the Association they “enable the savings and investment industry to speak with one voice and represent the unified goal of ensuring that this industry remains relevant and sustainable into the future in the interest not only of ASISA and its members, but also the country and its citizens” (ASISA, 2014).

Section 2.4.6 contains all reforms which have already been finalised since the start of 2014 and which look set to be implemented in the near future. This section thus, to a certain extent, also compares Treasury's proposals with what has actually been implemented. The five papers are presented in chronological order.

It is believed that National Treasury will at least implement some of their proposed reforms of the industry after careful consultation with industry stakeholders. Finally, it is again stressed that this chapter contains information as at the time of writing.

2.4.1 Enabling a Better Income in Retirement

The first paper presented by National Treasury, *Enabling a Better Income in Retirement*, presented an overview of the South African annuity market and examined the two main types of annuities offered in South Africa at retirement, namely living and conventional annuities (National Treasury, 2012a:3). The paper concluded with three main regulatory suggestions on improving the industry, based on Treasury's findings.

Living and conventional annuities were analysed separately so as to determine what level of reform, if any, is necessary for each of these products. The shortcomings of these products as were determined by Treasury are presented here, whereafter the three regulatory suggestions are discussed.

The main limitations of living annuities were found to be the fees levied on the annuitants as well as the substantial risk these products expose the annuitants to in terms of outliving their retirement capital, i.e. their longevity risk (National Treasury, 2012a:25).

Conventional annuities, on the contrary, offer protection against longevity risk, but it is believed that individuals nearing retirement do not consider the possibility of them living for 30 years post-retirement (National Treasury, 2012a:30). These products might not, however, expose annuitants to the preferable level of equity investments. Also, retirees might wish to leave a financial inheritance for those that are financially dependent on them – a feature not provided for by a standard conventional annuity (National Treasury, 2012a:30).

To bridge these shortcomings, three proposed reforms were presented (National Treasury, 2012a:36):

- 1) Reforming living annuities: Increasing competition amongst living annuity providers with the intention of reducing fees as well as the level of financial advice required by retirees.
- 2) Increased automation: Creating a default retirement product to which certain retirees, based on their retirement balances, are required to enrol. This should consequently increase the automation of the retirement process and ease the transition from pre- to post-retirement for retirees which in turn lessens the financial advice required.
- 3) Increased longevity protection: Decreasing the longevity risk retirees face whilst still providing the opportunity to have a significant equity exposure.

Firstly, it was argued that competition amongst living annuity products can be increased relatively easily. Annuities may currently only be sold by life insurance companies. As these products do not offer any form of guarantee, the products may for that matter be sold by any other financial provider, not just life companies (National Treasury, 2012a:36).

The paper also proposed a new type of legal vehicle from which retirement income can be paid. This vehicle, called a Retirement Income Trust (RIT), should be regulated in similar fashion to that of living annuities. It was proposed that RITs only differ in the following ways (National Treasury, 2012a:37):

- No investment choice should be permitted.
- Age-dependent drawdowns should be implemented.
- Asset allocations should be subject to more conservative legislation than that of Regulation 28 of the Pension Fund Act No. 24 of 1956.
- Only limited commission will be allowed.

The second proposed regulatory reform, increasing automation, has the intended effect of achieving higher longevity protection across the retirement industry. By creating a default annuity product which retirees can buy with their retirement capital, Treasury believes the current uncertainty that exists in the transition phase between pre- and post-retirement should diminish (National Treasury, 2012a:37).

Finally, the third proposed regulatory reform included the specific design of the default product mentioned in the second reform. Three products were proposed to be sufficient in providing increased longevity protection.

Firstly, a conventional annuity with certain built-in options such as spouse's protection was proposed. The second proposition was a variation of the RIT which would start off as a phased withdrawal product and gradually move the underlying assets into a conventional annuity. This would provide longevity protection in the later stage of a retiree's life. Finally, variable annuities were proposed. These annuities are similar to with-profit annuities described in Section 2.2.1.4. A standard with-profit annuity does not, however, pay any capital to the annuitant's dependents at the death of the annuitant, and a change in this product's current regulation would subsequently be required to ensure optimal alignment with the objective as required by National Treasury (National Treasury, 2012a:39, 41).

In response to this paper ASISA put forth their agreements and disagreements. The Association did not see it fit that reform should be heavily weighted toward prescribing product design (ASISA, 2012a:3). Instead ASISA proposed three steps that should, according to them, provide a more sustainable income in retirement.

These steps included preserving retirement capital, developing a *simple* default retirement product, and having the option to opt out of the product should retirees wish to do so (ASISA, 2012a:4).

2.4.2 Preservation, Portability and Governance for Retirement Funds

Retirement capital preservation can be defined as the act of not spending retirement capital when an individual switches employers. Treasury states that retirement savings for the average worker is the single largest source of post-retirement income (National Treasury, 2012b:3). It may thus be argued that retirement capital preservation rates should be relatively high. However, South Africa has a very low preservation rate and Treasury subsequently proposed changes in legislation in the second paper entitled *Preservation, Portability and Governance for Retirement Funds* that are aimed towards increasing preservation of retirement assets.

The paper is structured in three sections: pre-retirement preservation, provident and pension fund alignment, and pension fund governance.

The first section proposed certain legislation which would ultimately increase capital preservation. The legislative proposals included that all pension funds should be required to offer preservation of retirement capital as the default option when a fund member changes employers (National Treasury, 2012b:17). It was also proposed that these regulations should only apply to fund members who join the fund after the implementation date of the legislation. Existing members, i.e. those having belonged to a fund before the legislation was implemented, will be subject to the new regulation only in respect of growth of their retirement assets as well as any fund contributions after the implementation of new legislation. They will thus have vested rights (National Treasury, 2012b:17).

As described in Section 2.1 South African retirement funds differ in many respects. Harmonisation of the legislation of these funds with the eventual objective of reducing fund

costs and complexity was thus presented in the second section. Current provident fund legislation allows a retiree to take the full benefit in cash. Many members spend these funds without realising the long-term implication of their actions and are subsequently exposing themselves to significant longevity risk (National Treasury, 2012b:21). It was thus proposed to align provident funds with pension and retirement annuity funds in the form of mandatory annuitisation, i.e. members will be required to purchase an annuity with at least two-thirds of their retirement capital (National Treasury, 2012b:22).

The final section proposed that all trustees who are, amongst other duties, responsible for managing the retirement fund investment decisions should undergo financial training to ensure that they are suitable for the position. These trustees should also adhere to certain governance principles (National Treasury, 2012b:27).

ASISA was supportive of the proposals presented in this paper, including the vesting of fund member rights and increased fund governance. They, however, did caution against the complexity and costs that may arise due to vested rights of existing fund members (ASISA, 2012b).

2.4.3 Incentivising non-retirement savings

The third paper presented by Treasury focussed specifically on non-retirement savings as the name of the paper suggests – *Incentivising Non-Retirement Savings*. Non-retirement savings can be defined as any discretionary savings other than that which was set out specifically for retirement (National Treasury, 2012c:3). The focus of the paper also included the promotion of savings amongst low-to-moderate income households (National Treasury, 2012c:17). Treasury presented two reasons for incentivising non-retirement savings. These are, firstly, the need to improve the financial security of low-to-moderate income households and secondly, the prevalent negative savings rate of South Africa (National Treasury, 2012c:6).

One main proposition came from this paper. This proposition was also embraced by stakeholders with minimal amendments to the proposal and was implemented in 2015 (National Treasury, 2014c:18). The proposed non-retirement savings incentive, a tax free savings vehicle, would allow the South African public to invest in a certain fund and benefit from tax free withdrawals and growth in the underlying fund (National Treasury, 2012c:17). The approved product structure is explained in detail in Section 2.4.6.4, and the product as

was proposed by Treasury in this paper is explained below. This gives an idea of the extent to which Treasury's retirement reform proposals are altered after discussions with stakeholders, and before they are implemented.

The proposition was made that investors could choose between two underlying funds. A normal interest-bearing account, such as bank deposits, and an equity account, allowing for exposure to local listed equities, were proposed. Contributions would be capped at R30 000 annually with a maximum of R500 000 over the life of an individual. It was proposed that these limits be adjusted with inflation over time (National Treasury, 2012c:18).

Finally, because there are individuals who are nearing the end of their lives and subsequently could not access the full benefit of this new product from an early age, age contributions were also proposed. For instance, individuals 65 years and older may invest the full R500 000 over a transition period of two years (National Treasury, 2012c:18).

ASISA was mainly in favour of all the proposals in this paper. However, the Association did raise a concern that the proposals did not incentivise savings for non-taxpayers, i.e. individuals earning income below that of the minimum threshold (ASISA, 2013:24).

2.4.4 Improving Tax Incentives for Retirement Savings

The current retirement tax regime explained in Section 2.1.1.4 is deemed to be too complex and could be subject to abuse (National Treasury, 2012d:4). The fourth paper presented by National Treasury, *Improving Tax Incentives for Retirement Savings*, thus proposed certain legislation which attempted to simplify the current structure. The paper delves into significant technical detail and only the main conclusions are presented here.

Much of the proposed legislation was based on the 2012 National Budget Proposal. Firstly, it was proposed to harmonise the tax treatment of all retirement funds and to treat all employer contributions to retirement funds as fringe benefits. This implies that all employer contributions made on behalf of the employee are taxable in the hands of the employee. Furthermore, it was proposed that individuals should be allowed tax deductions for contributing to a retirement fund according to their age. Those 45 years and younger should be allowed a maximum of 22.5% and those older than 45 years will be subject to a cap of

27.5%. These percentages are applicable to the higher of employment or taxable income (National Treasury, 2012d:13).

Monetary caps on the above deductions were also proposed and were set at R250 000 for those 45 years and younger, whilst older individuals should be subject to a cap of R300 000. A minimum threshold of R20 000 was proposed which is deemed to allow low-income earners to contribute in excess of the proposed percentages (National Treasury, 2012d:13).

A concern raised by Treasury was the tax treatment of DB schemes. Because pension funds which operate as DB schemes pool all contributions, a disconnect arises between the contributions and benefits of fund members. It is thus not advisable to treat employer contributions as fringe benefits as the individual that will get taxed on the contributions might not be the individual who benefits from the contributions (National Treasury, 2012d:30). Two proposed solutions were presented, but a more robust solution than these two was deemed necessary (National Treasury, 2012d:32).

ASISA responded to these tax propositions mainly by stating their disapproval of the monetary cap levels. In their comments they argued that such a cap did not achieve any significant purpose and created administrative complexity whilst also creating problems for fund members with variable income (ASISA, 2013:22).

2.4.5 Charges in South African Retirement Funds

The fifth and final paper presented by National Treasury entitled *Charges in South African Retirement Funds* had the intended objective of facilitating engagements with stakeholders in reducing the charges of retirement funds that are levied during the accumulation phase of individuals' working career. The retirement fund charges of South Africa, when compared to other countries, have been found to be significantly higher (National Treasury, 2013b:15). The paper did not, however, present any specific proposals as a solution to the problem but rather offered several possible draft options (National Treasury, 2013b:3).

According to the paper each type of retirement fund currently offered in South Africa has its own drawbacks when analysed in terms of the costs and charges. Costs and charges were separately defined. Costs are implicit expenses of the retirement fund. These include administering the fund and benefits, and providing financial advice to members. Charges are

the actual fees explicitly levied on members which cover the expenses. These charges are typically accounted for by deducting them from contributions or by selling fund assets (National Treasury, 2013b:4).

Nine draft policy options with the intended objective of reducing retirement fund charges were presented and stakeholders' comments were yet to be publicly discussed at the time of writing (National Treasury, 2013b:57).

2.4.6 Reforms Approved for Implementation

Several of the proposed regulations in the five aforementioned papers have already been implemented, or have been approved to be implemented in the near future. These new regulations are discussed in this section. This section thus enables the reader to compare the approved and implemented regulations with what was proposed by Treasury, thereby providing a general idea of the likelihood of the other proposals by Treasury being implemented.

It should be noted that most of the new regulations were expected to be implemented on the 1st of March 2015, but due to significant opposition from labour unions the legislative changes were postponed to the 1st of March 2016. The possibility exists that it may be postponed by another year (Du Preez, 2015).

2.4.6.1 Taxation

As of the 1st of March 2014 the tax free lump sum that is commutable in cash from a retirement fund was raised from R315 000 to R500 000, but marginal rates of 18%, 27%, and 36% on amounts in excess of this tax-free amount still apply, depending on the amount commuted. This higher amount will especially benefit lower income households (National Treasury, 2014a:49; National Treasury, 2014b:6; SARS, 2015).

1 March 2016 has been set as the implementation date of the homogenisation of taxes on retirement fund contributions. The current complex contribution system as was explained in Section 2.1.1.4 is to be replaced with a new system. Firstly, employer contributions will be classified as fringe benefits which imply that these contributions will be taxable in the hands

of the individual. All contributions to pension, provident, and retirement annuity funds will be tax deductible subject to a maximum of 27.5% of the greater of remuneration or taxable income of the employee. An annual tax deductible cap of R350 000 will, however, apply (National Treasury, 2013a:1). Remuneration in the above context refers to an employee's salary including any benefits such as bonuses and leave pay, and excludes any retirement fund lump sum, lump sum withdrawal benefit or severance benefit. Taxable income is defined as an individual's total income received from all sources, less all allowable deductions and exemptions (Retirement Fund Contribution, 2014).

If the annual contribution made is greater than the cap, the excess amount may be rolled over for use in years when contributions are below the R350 000 cap. Individuals will also be allowed to add the nominal value of any unclaimed additional amounts to their tax-free lump sum at retirement (Cameron, 2014a).

The above information is applicable to DC schemes on an as-is basis, and although the new system is more simplistic and efficient in its design there is, however, still some complexity in DB fund schemes' tax deductibility. Under a DB scheme the total amount that an employee may deduct is computed through the use of a specific formula. This formula divides the total employer contribution into a DB and DC component. The formula is introduced in paragraph 12 D of the Seventh Schedule to the Income Tax Act No. 58 of 1962 (Retirement Fund Contribution, 2014).

What follows is an example of how this new system will work (Adapted from Retirement Fund Contribution, 2014):

Suppose John, a relatively wealthy individual, receives a total remuneration of R1 700 000 per year. His salary per annum equals R1 300 000 and he contributes 8% of his salary to his employer's DC pension fund. His employer contributes 15%. Furthermore, John has a separate retirement annuity fund to which he contributes 6% of his salary. He also has his own private business from which he receives R100 000 per annum. SARS allows R250 000 as deductible expenses in this regard. Table 2.2 depicts the calculation of the total amount John is allowed to deduct for tax purposes based on his retirement fund contributions:

Table 2.2: Tax Deductibility

Contributions		
Type	Calculation	Amount
Employer's contribution	R1 300 000 x 15%	R195 000
Employee's contribution	R1 300 000 x 8%	R104 000
Retirement annuity contribution	R1 300 000 x 6%	R78 000
Total		R377 000
Taxable income versus Remuneration		
Remuneration		
Remuneration		R1 700 000
Taxable income		
Salary		R1 300 000
Employer Contribution (taxable in employee's hand)		R195 000
Other income		R 100 000
Deductible expenses		(R250 000)
Taxable income		R 1 345 000

Source: Author (2015)

John has made contributions equal to R377 000 to retirement funds. This amount has to be compared with the R350 000 annual cap as well as with the 27.5% on the greater of his remuneration or taxable income. In the above scenario, John's remuneration was the greater amount. This implies he would be allowed to deduct 27.5% of his remuneration for tax purposes, subject to the annual cap.

Thus John, having contributed R377 000, is allowed to deduct R467 500 (R1 700 000 x 27.5%), but is subject to the R350 000 annual cap. John will subsequently deduct R350 000 at the end of the year in the calculation of his taxable income and roll an excess amount of R27 000 over to the next tax year.

If at the end of John's working career he still has a rolled over amount, he may deduct this amount from his one-third lump sum before calculating tax on that lump sum. Should the total amount rolled over exceed that of the lump sum, the deduction may be made against his pension (Retirement Fund Contribution, 2014).

2.4.6.2 Governance

Certain amendments were made to the Pension Fund Act No. 24 of 1956 which strengthened the governance of retirement funds by means of much stricter trustee regulations. Trustees will now, for example, be required to undergo financial training which should increase the general standard of their financial decision making. Also, the fiduciary duty of trustees has been clarified to such an extent that it is clear what is expected of them (National Treasury, 2014b:5).

Legislation has also been introduced which now makes the non-payment of retirement fund contributions by employers a criminal offence. Furthermore, financial officers and directors may be held personally liable. Fines of up to R10 million can be levied and financial officers and directors can face imprisonment of up to 10 years (Sanlam Intelligence, 2014).

In closed corporations and all other types of businesses the members who are regularly involved in the financial affairs of the firm will be liable to see to it that all contributions are made on a timely basis (Sanlam Intelligence, 2014).

2.4.6.3 Preservation, Fund Alignment, and Annuitisation

Government applies a significant tax penalty to individuals who withdraw their retirement savings in excess of certain thresholds before their actual retirement. This legislation is part of addressing the low preservation rate in South Africa. The main incentive behind these thresholds is to encourage individuals to preserve their retirement capital and not to make any withdrawals from their retirement funds, pre-retirement. Consider the following example: an individual who withdraws R1.05 million before retirement will have to pay tax of R225 000, but if the same amount is withdrawn at retirement, a total tax amount of only R130 500 is payable (Cameron, 2014a).

However, government is set to implement various other methods to encourage retirement capital preservation and improve the prevalent low preservation rate in South Africa (Cameron, 2014a).

The 1st of March 2016 has been set as the date on which a broad retirement fund alignment will take place. The low preservation rate has also been linked to individuals belonging to provident and provident preservation funds opting to commute all their retirement capital in

cash at retirement and neglecting to purchase an annuity which would provide them with an income for the rest of their lives. Thus, as from this date all provident and provident preservation funds will apply the two-thirds annuitisation rule as is currently imposed on pension and retirement annuity fund members. Finally, the *de minimus* threshold, currently R75 000, will be increased to R150 000. This implies that if an individual's accumulated retirement capital is less than R150 000, the mandatory annuitisation rule would not apply (National Treasury, 2014b:5; KPMG, 2014).

To accommodate current provident fund members the legislation will vest their rights. Members' balances on the 1st of March 2016 and subsequent growth on those funds will not be subject to the new law. These members will effectively each open an additional provident fund at the date of implementation which will fall under new legislation. Members who are 55 years and older at the date of implementation will not be affected in any way by the change in regulation (Lester, 2013b:3).

The following example is presented for clarification (Lester, 2013b:5):

Suppose John is 50 years old on the 1st of March 2016. His accumulated retirement capital at this stage was R450 000 and is invested in a provident fund. He retires on the 1st of March 2026 at the age of 60 and the underlying capital in the provident fund grew to R600 000. In the ten years after the implementation of the new legislation John contributed R80 000 to a new provident fund. This R80 000 grew to an amount of R120 000 in additional retirement savings over and above the R600 000.

According to the new legislation, John's R600 000 will not be subject to the mandatory annuitisation, but the extra R120 000 which was acquired after the 1st of March 2016 will be. However, because this amount is below the *de minimus* amount of R150 000 it will also be free of any mandatory annuitisation.

For all intents and purposes Treasury foresees the transition to this new system being completed by 2055 (National Treasury, 2014b:5).

2.4.6.4 Incentivising Non-retirement savings

A tax-free savings product as proposed in National Treasury's paper *Incentivising Non-Retirement Savings* has been implemented on 1 March 2015. The ultimate objective of this

savings vehicle is to improve the savings rate amongst South African citizens, indirectly enhancing and nurturing a retirement savings culture (National Treasury, 2014c:3).

In essence the product is structured as a bank account, allowing for deposits and withdrawals. There are four components to this product which differentiate it from a normal savings account: an annual contribution limit, the treatment of withdrawals, underlying investment accounts, and a lifetime contribution limit.

The annual contribution limit of R30 000, increasing on a regular basis to provide protection against inflation, is set in place so as to address the procrastination problem individuals face. This problem arises when an individual repeatedly postpones decisions. It is not so much the amount that matters, but rather the deadline of the annual contribution. It is believed that this will encourage individuals to make timely annual contributions to the tax free fund, thereby improving the savings rate of South African citizens (National Treasury, 2014c:8).

Withdrawals from the fund will be allowed but a lifetime contribution limit of R500 000 will apply. This implies that individuals may make withdrawals from their funds, but these withdrawals may not be replaced. The motivation behind this particular legislation is to have individuals prudently consider their rationale for making any withdrawals (National Treasury, 2014c:8).

Underlying investments consist of equity and interest bearing investments. Investments are in the form of unit trusts, fixed deposits, bank savings accounts, retail savings bonds and certain exchange-traded funds. However, direct share purchases do not form part of the permissible investments (National Treasury, 2014c:4).

2.5 Conclusion

Chapter Two provided a holistic view of the retirement industry of South Africa. It elaborated on how the industry functions with regards to the public and private pension schemes as well as how tax is imposed on individuals when dealing with pensions. The chapter further gave an overview of the current annuity options available to South African retirees and provided a description of international annuities too. A section on the current retirement reform was presented as a conclusion to the chapter.

It is believed that when analysing and researching a certain aspect of the retirement industry, such as annuities in this study, one has to keep all the different areas of the industry in mind so as to form constructive arguments and to deliver a comprehensive result or opinion.

Chapter 3

Literature Review

This chapter identifies and compares the previous research studies which have been conducted with regards to annuity products providing an income in retirement. The chapter is structured in two separate sections. South African annuity research is discussed first, whereafter international studies follow. This specific distinction between South African and international research is made as it was indicated in Chapter Two that annuity products differ significantly across various countries.

3.1 South African Annuity Research Studies

To the author's knowledge there have been nine South African annuity-based research studies conducted. It should be noted that five of the nine studies were in completion of either Master's degrees, or conducted by qualified actuaries. The remaining four studies were conducted in completion of an Honours or MBA degree and consequently are not as comprehensive as the other five studies.

These nine papers are presented in this section with a summary of their key differences being provided at the end. The papers are presented in chronological order.

3.1.1 Baldeaux (2005)

Baldeaux (2005:i) assessed the appropriateness of living annuities as a source of retirement income relative to inflation-linked annuities by constructing a ruin probability model. Two main objectives were established that quantified the level of appropriateness.

The first objective, measured in the first test, was to quantify the risk associated with a living annuity, subject to the income needs of the pensioner. The second objective, measured in the second test, was to determine whether an inflation-linked annuity would be more appropriate in providing an income as opposed to a living annuity, given that the first test suggested an

acceptable level of risk. The second test was further divided in two sub-tests. Firstly, only the benefits paid by the living annuity were used in obtaining a result for test two. Secondly, the benefits paid as well as the underlying fund value at the time of the annuitant's death were used in determining a result (Baldeaux, 2005:i).

These tests were conducted using a ruin benchmark so as to obtain a ruin probability. Two variables were required to compute the ruin probability. These included the annuitant's income needs and a benchmark definition which could be used to compare the income of the living annuity.

The income needs of the annuitant were represented by a reduction percentage and defined as follows: an inflation-linked annuity purchased at age 65 was assumed to provide an initial annual payment of P . This amount was assumed to be sufficient to cover all income needs. The reduction percentage, labelled r , was subject to certain bounds and when multiplied with P would be the absolute minimum annual payment the living annuity would have to provide to cover the annuitant's income needs. The benchmark was defined as the cost of an inflation-linked annuity at an initial payment $P(r)$, adjusted for annual inflation since the 65th birthday of the pensioner. Ruin was defined as the fund value falling below that of the benchmark, or if the fund value became negative at any point during the retiree's life. These ruin probabilities were measured at each anniversary of the living annuity (Baldeaux, 2005:i).

A fictitious male retiree, aged 65, was assumed to retire with R1 000 000. Either an inflation-linked or living annuity could be purchased with this amount. The annuitant's life expectancy was subject to the PA(90) mortality table (Baldeaux, 2005:4).

Models for determining asset returns and annuity benefits were constructed and applied to a stochastic Monte Carlo model. Returns for four asset classes were simulated: local equity, local property, local fixed interest, and offshore investments. Each assets class was modelled based on a specific proxy and certain correlation assumptions (Baldeaux, 2005:19). Furthermore, inflation as measured by the Consumer Price Index (CPI), as well as exchange rate risk were also modelled. The Monte Carlo simulation was run 1 000 times and the returns for each of the four asset classes were simulated for 45 years (Baldeaux, 2005:24).

Six asset allocations were constructed in which the living annuitant could invest. A sub-objective of the study was to determine whether or not the living annuitant could benefit from asset diversification. A second sub-objective was to determine which specific allocation

would fare best in terms of each of the two main objectives (Baldeaux, 2005:25). As the living annuity was analysed relative to the inflation-linked annuity, the drawdown rates were subject to the benefit generated by the inflation-linked annuity.

The first objective, as measured by the first test, assumed that the living annuitant only withdrew $P(r)$, adjusted for inflation as from his 65th birthday. This drawdown was subject to the legal limits in 2005 which were set at a minimum of 5% and a maximum of 20% (Baldeaux, 2005:32,35). For the second test to be conducted, however, two additional concepts had to be introduced: an extra and excess percentage.

The extra percentage was defined as the percentage of the amount by which the underlying living annuity fund *exceeded* the benchmark at any anniversary. This amount was to be paid out as an extra payment over and above $P(r)$, adjusted for annual inflation as from the 65th birthday of the pensioner (Baldeaux, 2005:33).

The excess percentage was defined as the amount the underlying living annuity fund *had to* exceed in order for the annuity to make an extra payment over and above $P(r)$ in the following year, as was determined by the extra percentage. The amount was expressed as a proportion of the cost of an inflation-linked annuity with an initial payment P , adjusted for inflation since the 65th birthday of the pensioner (Baldeaux, 2005:ii,32).

The first objective, as measured by the first test, assumed the annuitant annually withdrew $P(r)$, adjusted for inflation. The results for this test, for a low reduction percentage of 65% (i.e. low income needs), showed that the subsequent ruin probability of the living annuity was also low. The probability was minimised, given a certain asset allocation, at 0.069. The risk, however, increased when the income needs, or reduction percentage, was increased. A 90% reduction percentage increased the ruin probability to 0.457 (Baldeaux, 2005:ii).

The second objective, which had two sub-objectives, was performed with a 65% reduction percentage assumption. Should the bequeathing factor be ignored, i.e. the terminal value of the living annuity, the asset allocation and drawdown strategies would have needed to be too aggressive to have provided a sufficient retirement income. As a result it was concluded that an inflation-linked annuity was the superior product. However, when the bequeathing factor was introduced the living annuity appeared to be the superior product (Baldeaux, 2005:ii,67).

Diversifying between asset classes was found to outperform strategies that did not diversify. The simple allocation strategy that allocated 25% to each asset class proved to be superior and

the probability of ruin under this strategy could not be substantially improved on (Baldeaux, 2005:66).

3.1.2 Beinash (2007)

Beinash (2007:1) is the only South African-based study which utilised primary research to obtain a better understanding of the living annuity advisory process. The advisory process, i.e. the financial advice living annuitants receive from their financial advisors, includes factors such as the assessment of their risk appetite and the subsequent asset allocation decision. The author also constructed a mathematical model in analysing living annuities which was used to determine an appropriate asset allocation and income drawdown rate. The analysis was conducted by means of financial ruin probability.

Ruin was defined as the maximum income that the living annuity could provide, subject to the legal drawdown limits, falling below that of the minimum income that was required for living expenses. The minimum income level was set at an initial 4% of the underlying fund value and was assumed to remain constant as investment returns were calculated on a real basis (Beinash, 2007:10,12).

A female annuitant, aged 65, was assumed to retire with R1 000 000 which was used to purchase a living annuity. The PA(90) mortality table was used in determining the annuitant's life expectancy (Beinash, 2007:11,14).

Measuring the first objective, i.e. reporting on the financial advisory process, was accomplished by means of a survey which was distributed to qualified financial advisors in the Johannesburg area (Beinash, 2007:5).

The second objective required a stochastic Monte Carlo model to be constructed. Ultimately, the results would determine a suitable asset allocation and stable income drawdown rate for the living annuitant. The inputs to the model were as follows: the returns for five different asset classes were simulated over a 50 year period with the model being run 10 000 times per asset class. Inflation was modelled implicitly in the simulation through real asset returns (Beinash, 2007:12,13).

The asset classes modelled were local equity, long-term index-linked bonds, long-term conventional bonds, short-term conventional bonds, and one-year index-linked bonds. Eight

different portfolios were constructed, each with different weightings in the respective asset classes (Beinash, 2007:13).

A sensitivity analysis was also conducted to measure the effect of a variation in the three main assumptions of the model: the annuitant's retirement age, the constant initial drawdown rate (which is also the minimum income required), and drawing down at an initial rate higher than the minimum income required (Beinash, 2007:17,19,21). The probability of ruin, as well as an average time of ruin, was calculated in analysing the different drawdown rates and asset allocations.

The author concluded that, based on the survey results, advisors generally did not recommend drawing more than 5% to 8% of the underlying fund value per annum. No relationship between the quality of advice and the advisors' qualification could be determined. Furthermore, it was believed that living annuities might well be miss-sold due to the advantage they hold of being able to bequeath one's remaining fund value at the time of death. It was argued that retirees consequently do not consider the benefits of alternative annuity products, which might be more appropriate products, as they react solely on the bequeathing rationale (Beinash, 2007:22).

The mathematical model suggested that a 65 year-old retiree who invested in a living annuity would only be able to sustain a drawdown rate of 3%. For a 75 year-old retiree the sustainable rate was determined to be 4% per year, and in some instances 5% could be maintained although this was subject to the asset allocation. Generally it was found that a portfolio with 50% allocated to long-term index-linked bonds, 25% to long-term conventional bonds, and 25% to short-term conventional bonds performed best (Beinash, 2007:17). The results suggested that a larger percentage should be allocated to equity investments as drawdown rates increased (Beinash, 2007:18).

3.1.3 Goemans and Ncube (2008)

Goemans and Ncube (2008:i) compared level, 5% escalating, living, and with-profit annuities by means of an expected present value and ruin probability approach. The main objective was to establish the annuity strategy which would have provided the greatest lifetime income to a retiree.

A fictitious male retiree, aged 60, was assumed to have retired on the 31st of December 2007 with R500 000 which could be invested in either one of the four annuity products. Life expectancy was assumed to follow that of the South African Annuitant Standard Mortality Tables (SAIML98 and SAIFL98). An allowance was made for mortality improvements by means of a reduction of one year for every twenty years projected (Goemans & Ncube, 2008:18).

The authors made use of sophisticated asset projection software in forecasting asset returns for local equity and fixed interest investments. Monthly returns were projected for a period of 30 years through the generation of 1 000 scenarios (Goemans & Ncube, 2008:16).

Level and escalating annuity benefits were calculated through simulating annuity rates. With regards to living annuity benefits, five asset allocations were formulated, ranging from 100% invested in equities and 0% in bonds, to 100% in bonds and 0% in equities. Seven initial drawdown rates were analysed, starting at 2.5% and increasing to 17.5% in increments of 2.5%. Three drawdown strategies were modelled. Firstly, a constant drawdown rate throughout the investment period was maintained. Secondly, the drawdown percentage was adjusted to maintain the Rand amount of income, and thirdly, the drawdown percentage was adjusted to annually increase the Rand amount by 5%. Benefits paid by the with-profit annuity were the most difficult to simulate due to the uncertainty surrounding the projections of the underlying components. The initial guaranteed income, the underlying investment strategy, bonus declaration and return smoothing were all simulated (Goemans & Ncube, 2008:23,25).

The authors defined two ruin benchmarks against which the annuities were measured. Firstly, ruin was defined as the initial level of income not having been maintained. The second benchmark was defined as the annuity benefits not increasing by 5% (Goemans & Ncube, 2008:32).

The study revealed that, in terms of living annuities, it should be possible for an individual to maintain a Rand amount of income drawdown for as long as the initial drawdown percentage did not exceed 7.5%. Based on a 50% equity allocation, this drawdown strategy yielded a 47% ruin probability after 30 years (Goemans & Ncube, 2008:34). However, having adjusted the ruin probabilities for mortality improvements it was found that a 25% exposure to equities was the optimal allocation over a 30 year investment horizon (Goemans & Ncube, 2008:37).

When the likelihood of maintaining a 5% increase in income was considered, the authors found that the with-profit annuity provided the highest level of initial income, but the ruin probability was above 50%. While the 5% increasing guaranteed annuity provided a similar level of initial income it did so with no ruin probability. It was found that with an initial drawdown rate of 2.5% or 5%, the living annuity could be managed to provide an increasing income stream at relatively low risk (Goemans & Ncube, 2008:40).

The authors also concluded that, based on further analysis of expected present values, with-profit and escalating annuities outperformed living annuity strategies, but it was not clear which of the two (with-profit or escalating annuities) was superior (Goemans & Ncube, 2008:44).

Upon analysing deferment of annuitisation the authors found that deferment was beneficial to annuitants. However, any deferment strategy was still inferior to immediate annuitisation, i.e. the retiree should have purchased a guaranteed annuity at retirement (Goemans & Ncube, 2008:47).

3.1.4 Rudman (2009)

The objective of Rudman (2009:ii), with specific reference to living annuities, was to establish an optimal asset allocation that would minimise investment, drawdown and longevity risk. To date, this has been the only South African-based study to have included an analysis of both pre- and post-retirement phases.

Pre-retirement income modelling was conducted as follows. Individuals with different retirement ages (55, 60, 65, and 70) were assumed to have started contributing to a pension fund at the age of 25. Monthly pre-retirement income was based on the Living Standard Measurement, a measure that divides the South African population into 10 income groups, based on their living standards. Rudman (2009:49), however, only considered three levels of *final* income (the last monthly salary earned prior to retirement) of R1 500, R3 500, and R11 000. These figures were discounted at the historic inflation rate to the age of 25. Three annual contribution rates, as a percentage of annual salary, of 9.3%, 11.3%, and 13.3% were tested. The pre-retirement capital was assumed to grow at either 8%, 10%, or 12% (Rudman, 2009:49).

Post-retirement income was modelled as follows. The concept of a Net Replacement Ratio (NRR) after retirement was used. The NRR divides a pensioner's post-retirement earnings by the final salary received at retirement. Thus, the NRR is a measurement of living standards post-retirement relative to pre-retirement. Three NRR's of 28%, 50%, and 75% were tested. The annual drawdown of the living annuity was set to match the required NRR, subject to the drawdown limits (Rudman, 2009:50).

The retiree was assumed to retire on the 20th of July 2004. Life expectancy was simulated through a risk model that considered smoking status, monthly income, and level of education.

As the primary objective of the study focussed on optimal asset allocation strategies, the modelling of asset returns was a crucial element in this study. Modelling was conducted by stochastically simulating the returns for four South African unit trust sectors namely Equity, Real Estate, Asset Allocation, and Fixed Interest. The returns were simulated for 35 years. These categories each have their own definition as per the tier classification of South African unit trusts. In total, 15 different portfolios were constructed, each with different weightings in these four categories (Rudman, 2009:51,63).

With each of the fifteen investment portfolios the time to financial ruin was determined. Ruin was defined as the "monthly income falling below the original income amount considering the maximum withdrawal rate of 17.5%" (Rudman, 2009:52).

The results indicated that, for a retiree who maintained an average contribution rate of 11.3% and managed an investment growth of 10%, a portfolio consisting solely of Fixed Interest unit trusts performed worst. A full exposure to Real Estate investments performed best. A NRR of 28% was deemed a sustainable replacement ratio for all retiree ages analysed. As from the age of 65 onwards, all portfolios appeared to generate sufficient returns to sustain a NRR of 50%. The earliest time to ruin was 19.8 years for this replacement ratio. Based on these assumptions a NRR of 75% was, however, not obtainable (Rudman, 2009:70). With an average contribution rate of 13.3% and an investment growth of 12% assumed (the most aggressive strategies), all the portfolios were able to support a 75% NRR for individuals retiring at ages 65 and 70 (Rudman, 2009:75).

3.1.5 Levitan, Dolya and Rusconi (2009)

The study by Levitan, Dolya and Rusconi (2009:1,5) considered income provision choices, i.e. annuity options, for South African individuals in retirement. The authors analysed level, three percent escalating, inflation-linked, and living annuities by means of a ruin probability model.

Ruin was defined as the individual's income falling below that of a certain standard of living (Levitan, *et al.*, 2009:4). Two monthly benchmark income levels were constructed, classified as comfort and necessity levels and assigned the initial values of R8 000 and R5 500, respectively (Levitan, *et al.*, 2009:8). The probability of ruin calculated the likelihood of the individual not being able to sustain these initial values in real terms (Levitan, *et al.*, 2009:9).

A male retiree, aged 65, was assumed to retire with R1 000 000 which could be used to purchase any one of the four annuities analysed. The annuitant's life expectancy was modelled stochastically by simulating random numbers assuming a Uniform distribution (Levitan, *et al.*, 2009:4,10).

A stochastic Monte Carlo model was designed to simulate equity and nominal government bond returns as well as inflation. Market neutral parameters as at 1 July 2009 were used in determining the appropriate inputs to the model. The model was run 3 000 times and simulated the factors for a period of 40 years. Conventional annuity rates and their benefits could be derived from the simulated bond yields and inflation levels. Four asset allocations for the living annuity were modelled with the weights allocated to equity investments being 0%, 25%, 50%, and 75% and the remainder allocated to bonds. The annual living annuity drawdown was subject to the legal drawdown limits. It was assumed that the annuitant would increase his annual drawdown with inflation (Levitan, *et al.*, 2009:7,10).

The authors concluded that the inflation-linked annuity, when measured against the comfort benchmark, had a substantial ruin probability of 97.20%. However, should the initial income required be equal to or below the necessity benchmark, the ruin probability reduced to 0%. This implied that the inflation-linked annuity could be sufficient in providing an inflation adjusted income for life at the necessity level (Levitan, *et al.*, 2009:12).

When the guaranteed annuities were compared with one another it was established that the escalating annuity provided the minimum ruin probability for monthly income levels between

R6 000 and R7 000. For income levels in excess of R7 500, the level annuity provided the minimum ruin probability (Levitan, *et al.*, 2009:12).

However, when a living annuity was introduced to the analysis the results showed that this product, with a 75% exposure to equities, was deemed the superior option. This result held when tested against a comfort income level, but the inflation-linked annuity performed best when measured against the necessities income level (Levitan, *et al.*, 2009:13).

Table 3.1 summarises the ruin probability results by Levitan, *et al.* (2009:14).

Table 3.1: Ruin Probability Results

Results		
Investment Strategy	Income requirement of R5 500	Income requirement of R8 000
Level Annuity	71.70%	88.30%
3% p.a. Escalating Annuity	53.50%	91.40%
Inflation-linked Annuity	0.00%	97.20%
Living Annuity	40.6%	70.3%

Source: Levitan, *et al.* (2009:14)

3.1.6 Lodhia and Swanepoel (2012)

Lodhia and Swanepoel (2012:119) analysed living and inflation-linked annuities in a unique way. The authors did not make use of ruin, expected present values, or discounted utility methods as incorporated by all other studies in their analysis. The ultimate objective was to determine whether or not a living annuity would be able to provide a minimum real income for life, and also to compare this income to that provided by an inflation-linked annuity.

Their study applied a breakeven analysis, that is, it analysed whether or not it would be possible for a living annuity to match the performance of an inflation-linked annuity. Breakeven for a living annuitant was defined in terms of the inflation-linked annuity. It was argued that a living annuitant should, at any given age in the future, be in the same financial position as he would have been had he annuitised at retirement (Lodhia & Swanepoel, 2012:124).

Five factors influencing the benefits payable by these two annuities were analysed separately. Each factor was, however, assigned its equivalent factor from the opposing annuity. For

example, benefits receivable from the inflation-linked annuity were linked to those receivable from the living annuity. The five inflation-linked annuity factors and the corresponding living annuity factors are presented in Table 3.2. By holding all but one of the factors constant the authors could analyse by how much the equivalent factor from the living annuity had to outperform the inflation-linked annuity factor in order to break even (Lodhia & Swanepoel, 2012:124).

Table 3.2: Breakeven Framework

Factor	Inflation-linked annuity	Equivalent	Living annuities
1	Mortality pooling	?	Cap on drawdown rate
2	Investment returns	=	Investment returns
3	Annuity payment	=	Drawdown payment
4	Interest rate	=	Interest rate
5	Initial capital	=	Initial capital

Source: Lodhia and Swanepoel (2012:124)

A fictitious male retiree was assumed to retire with R1 000 000 at the age of 65. The retiree's life expectancy was based on the PA(90) – 3 mortality table. The asset returns were derived from an investment model. This model was calibrated to deliver nominal returns of 8%, an inflation rate of 5.5%, and thus a real return of 2.5%. The initial benefit paid by the inflation-linked annuity was a function of age, interest rates and mortality assumptions. Finally, the living annuitant was assumed to draw down the same amount as the inflation-linked annuity, subject to the legal drawdown limits (Lodhia & Swanepoel, 2012:121).

The results were presented on a factor by factor basis. Firstly, the authors acknowledged that mortality pooling and the cap on living annuities are not directly comparable. Nevertheless, they argued that, all other things being equal, an inflation-linked annuity provides a more attractive expected income. This first factor thus analysed whether or not the living annuity could maintain the same benefit payout as the inflation-linked annuity (Lodhia & Swanepoel, 2012:126). Figure 3.1 presents the result as was obtained.

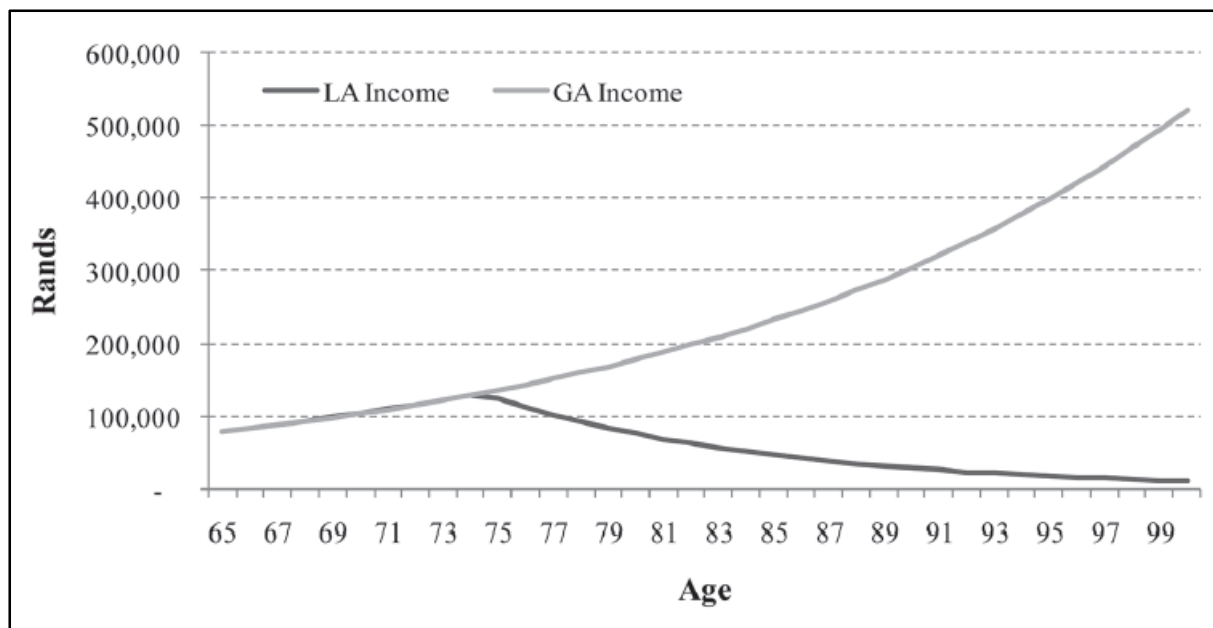


Figure 3.1: Annual Annuity Income by Age

Source: Lodhia and Swanepoel (2012:128)

Figure 3.1 indicates that a living annuitant would only be able to match the income provided by an inflation-linked annuity up until the age of 75, whereafter the drawdown cap is reached and the income starts to decrease.

With the regards to investment performance the authors concluded that an individual who deferred annuitisation by ten years would need to generate investment outperformance of 3% per annum, or CPI + 5.5%. This outperformance should have occurred in each of the ten years after deferment. It was also noted that this outperformance should be acquired on a risk-free basis as the inflation-linked annuity provided a guaranteed income (Lodhia & Swanepoel, 2012:130).

The annuity payment versus the income drawdown factor delivered the following result. An individual who deferred annuitisation by ten years, and who required a sufficient capital balance in ten years to secure a subsequent income equal to the expected income of an inflation-linked annuity, would have been required to draw 68% of the annual income provided by the inflation-linked annuity (Lodhia & Swanepoel, 2012:131).

The fourth factor determined what percentage of initial additional capital would have been required by a living annuitant at the age of 65 in order to break even with the inflation-linked annuity. Figure 3.2 presents these results.

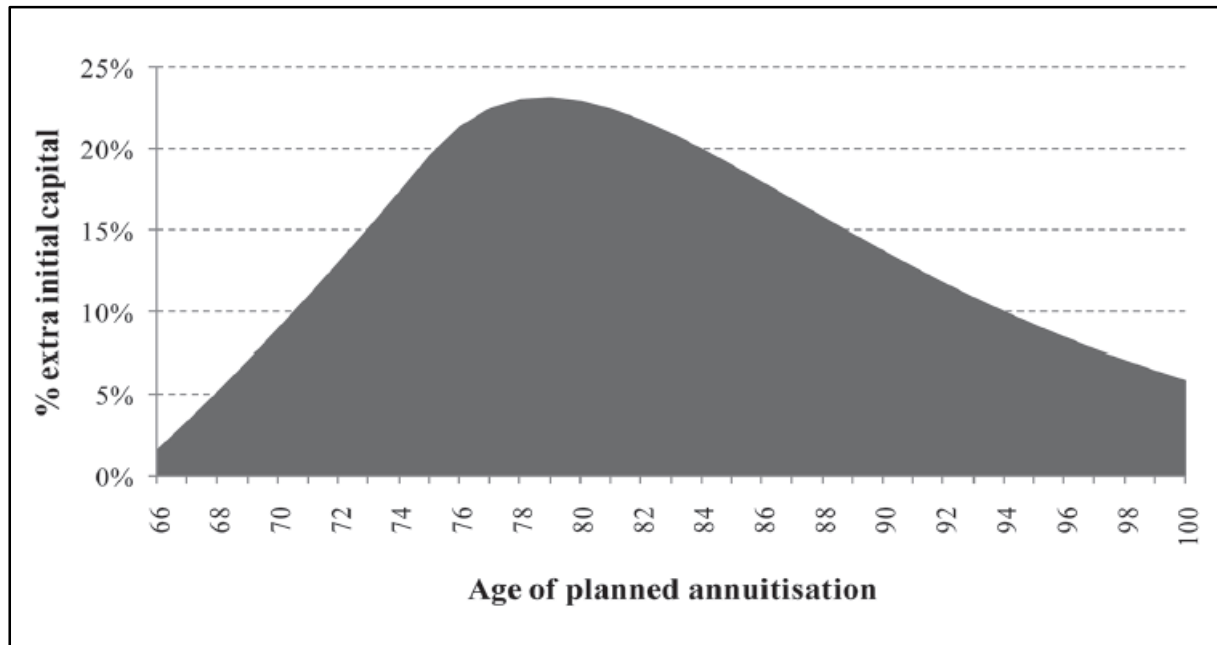


Figure 3.2: Initial Additional Living Annuity Capital Required

Source: Lodhia and Swanepoel (2012:133)

The results indicated that a living annuitant, aged 75, would have required an additional 20% in initial capital. This implied that a living annuitant with an initial capital balance of R1 200 000, who purchased an inflation-linked annuity at age 75, would have been in the same financial position as an inflation-linked annuitant who annuitised at age 65 with an initial capital balance of R1 000 000 (Lodhia & Swanepoel, 2012:134).

The interest rate factor results indicated that a living annuitant, deferring annuitisation by ten years, will be able to break even with the inflation-linked annuity should real rates have increased from 2.5% to 13.2%. No change in real rates could be determined for periods longer than 14 years (Lodhia & Swanepoel, 2012:136).

The authors concluded that, while living annuities are appropriate retirement products for some retirees, the recent sales of these products are driven by distorted factors such as misguided incentive schemes. This could potentially be a threat to South African pensioners, and possibly the financial industry as a whole (Lodhia & Swanepoel, 2012:119).

3.1.7 Butler, Hu and Kloppers (2013)

The study by Butler, Hu and Kloppers (2013:187) had three main objectives. Firstly, the highest ranking annuitisation strategies under two different measurement functions were established. The second objective determined whether different measurement functions, such as discounted utility and expected present values, suggested different annuitisation decisions. Finally, a sensitivity analysis based on the parameters assumed was conducted. Four different annuity products were analysed namely level, 5% escalating, inflation-linked, and living annuities. Furthermore, four switching strategies were also analysed in terms of which an inflation-linked annuity was purchased at a later stage in life by a living annuitant. The assumption was made that the living annuitant had maintained one of four fixed asset allocations throughout the investment period (Butler, *et al.*, 2013:195).

The two measurement functions used in this paper were discounted utility and ruin probability. The discounted utility model measured the degree of human satisfaction offered by a specific outcome. It was argued that an individual would select an annuitisation strategy that maximised expected discounted utility, given certain axioms (Butler, *et al.*, 2013:190).

The ruin probability was measured in terms of the strategy that would yield the lowest lifetime probability of ruin (LPoR). The LPoR measured the probability of depleting one's entire wealth before death (Butler, *et al.*, 2013:191). The ruin benchmark was defined as income falling below an initial stipulated comfort or necessity income level, which was increased annually by simulated inflation (Butler, *et al.*, 2013:202).

A number of fictitious retiree scenarios were created, as indicated in Table 3.3. The authors state that these cases were deemed reasonably realistic South African retiree scenarios. They also argued that by including the different cases one could determine whether or not a change in the demographic profile would affect the optimal annuity choice. Though cases 5 and 6 are the same in terms of the demographic profile, they differ with regards to the initial income requirement (Butler, *et al.*, 2013:196).

Table 3.3: Retiree Scenarios

Case	Main member age	Gender	Spouse	Income requirement in first year as a percentage of initial accumulated wealth	
				Necessities	Comfort
1	65	Male	61	5.16%	6.60%
2	60	Male	56	5.16%	6.60%
3	65	Male	-	5.16%	6.60%
4	65	Female	69	5.16%	6.60%
5	65	Male	61	4.20%	5.64%
6	65	Male	61	6.00%	7.44%

Source: Adapted from Butler, *et al.* (2013:196)

The comfort case was assumed to have provided the individuals with sufficient income so as to allow them to live comfortably. In contrast, the necessity case implied that income levels drawn matched the cost of living. The retirees in all cases were assumed to have retired with R1 000 000 which was used to purchase the annuities (Butler, *et al.*, 2013:196,201).

The annuitants' life expectancy was stochastically simulated based on the PA (90) mortality table and adjusted downward by three years for males and two years for females. The mortality expectations for both genders were improved by 1.5% per year as from 2012 onwards (Butler, *et al.*, 2013:198).

Benefits paid by the different annuities were either stochastically modelled or based on actual annuity market quotes. The initial benefit paid by the inflation-linked annuity was increased annually by stochastically generated inflation simulations. The living annuity benefits simulated were determined by the comfort or necessity case, subject to the legal drawdown limits (Butler, *et al.*, 2013:197).

The study by Butler, *et al.* (2013:196) is the only South African study to include a provision for spouses. The provision was made by pricing all conventional annuities analysed inclusive of a 75% spouse's provision. This implied that the main annuitant's spouse would continue to receive, after the main annuitant's death, 75% of the benefit that was payable had the main annuitant still been alive. The annuities were also priced with a ten-year guarantee term.

The study utilised the Maitland stochastic investment model parameterised by the following (Butler, *et al.*, 2013:197):

- Bond yields were used as at 31 March 2012.
- Ten-year nominal bonds were set to yield 8.3%.
- Equities were expected to yield 11.3% annually, in nominal terms.
- The expected inflation rate was calibrated to an annual average of 5.8% over ten years.

The model was run 2 500 times for each strategy involving living annuities or switching strategies.

The strategies that were modelled included the level, 5% escalating, inflation-linked, and living annuities with four asset allocations modelled. These allocations ranged from 0%, 25%, 50%, and 75% allocated to equities, with the remainder invested in bonds. The four living annuity strategies were also tested as switching strategies where, upon the age of 75, the annuitant purchased an inflation-linked annuity with the remainder of the underlying fund value (Butler, *et al.*, 2013:195).

The authors concluded that for each of the six retiree scenarios constructed, the discounted utility model ranked the aggressive living annuity strategy as the worst performer, i.e. the 75% equity allocated strategy. However, the ruin theory model ranked this strategy relatively highly (sometimes the best performing strategy) for each of the scenarios (Butler, *et al.*, 2013:213). This was a common phenomenon as, under most circumstances, the ruin model suggested different strategies than the expected discounted utility. This result suggests that great care needs be taken when analysing annuity products.

The results obtained under the ruin model for each of the six cases in Table 3.3 are presented in Table 3.4.

Table 3.4: Ruin Model Results

Case	Necessity Income		Comfort Income	
	Best	Worst	Best	Worst
1	5% Escalating	Inflation-linked	Living 75/25	Inflation-linked and 5% Escalating
2	Living 75/25	Inflation-linked	Living 75/25	Inflation-linked and 5% Escalating
3	Inflation-linked	Level	Inflation-linked	Level
4	Inflation-linked	Level	Living 75/25	Inflation-linked and 5% Escalating
5	Inflation-linked	Level	Living 75/25 and Living 50/50	Inflation-linked
6	Living 75/25 and Living 50/50	Inflation-linked	Living 75/25	Inflation-linked and 5% Escalating

Source: Constructed from Butler, *et al.* (2013)

From this table it is clear that the ruin model favours living annuities with a high exposure to equities (75%) if it is assumed that the annuitants want to live comfortably. Inflation-linked and 5% escalating annuities are the worst performers in this case. With a necessity income benchmark assumed the results are mixed, but aggressive living annuity strategies still prevail, never having a ruin probability greater than 30%.

In conclusion, the authors felt that the results from the discounted utility model were more in line with human behaviour. For example, it may be argued that annuitants who are faced with higher income requirements, relative to capital available, would rather opt for a risk averse investment – a result indicated by the discounted utility model. The ruin model suggested risk tolerant investments for higher income requirements (Butler, *et al.*, 2013:215).

3.1.8 Theron (2013)

Theron (2013:1,5) analysed living and inflation-linked annuities and attempted to establish which is most appropriate for high net worth individuals.

A high net worth individual was defined as a person who has compulsory retirement savings as well as a large asset base of non-pension savings. The non-pension savings was used to supplement the income, should a shortfall in income provided by either one of the annuity products have occurred. The annuities were compared based on the number of years the annuitant could sustain himself, given a certain annual expenditure. Should the annuities have been able to sustain the annuitant, the comparison was made based on the amount of money available to beneficiaries at the death of the annuitant (Theron, 2013:4,5).

A 60 year-old male was assumed to retire with R10 000 000 in non-pension savings and R2 000 000 in compulsory pension savings. Either a living or an inflation-linked annuity was purchased with his compulsory pension savings (Theron, 2013:5). The annuitant's life expectancy was based on the male rates in the RVM92 standard tables and was adjusted by a factor of 104.74% (Theron, 2013:12).

A stochastic model was constructed in determining the appropriateness of the annuity products. The following inputs to the model were used: inflation was assumed to equal 5.9% over the entire investment period. Annual living annuity fees equalled 2.5% of the underlying fund value. Life annuity fees equalled an initial R1 500 with an annual deduction of R300, increasing with inflation. The annuitant's annual expenditure was assumed to be an initial 8% of non-pension savings and this amount increased annually by inflation. Investment returns were stochastically modelled based on the historic data of Regulation 28 compliant Balanced Funds offered by South African fund managers. Investment returns were generated for 51 years by running a Monte Carlo model 2 000 times (Theron, 2013:12,13,16).

A cash flow model was then constructed using the above information. The steps in projecting cash flows were as follows (Theron, 2013:15):

- 1) Available non-pension savings were increased with the assumed investment return.
- 2) The income from the life annuity was added to the amount in Step 1.
- 3) The annual withdrawal was deducted from the amount in Step 2.
- 4) This yielded a net amount which was added to/subtracted from the non-pension savings portfolio.

- 5) The previous steps were repeated until the annuitant's death.

This cash flow model recorded the year in which non-pension savings had been depleted.

The cash flow from the living annuity was used in supplementing the non-pension savings. Should the non-pension savings not have been sufficient in covering annual expenses, a drawdown from the underlying fund was made to cover the shortfall. This drawdown was subject to the 17.5% drawdown limit. If the non-pension savings were sufficient, a drawdown of 2.5% was made (Theron, 2013:15).

The author concluded that, under the base case assumptions, the life annuitant became insolvent after 25 years compared to a living annuitant who became insolvent after 22 years (Theron, 2013:17). A sensitivity analysis, based on five variables, revealed that the conventional annuity is the more sensitive of the two annuities. Small changes in the variables resulted in large changes in the time to insolvency. Table 3.5 presents the probability of solvency past certain ages.

Table 3.5: Probability of Solvency for Certain Ages

Results		
Ages	Living Annuity	Conventional Annuity
80	82.4%	91.1%
90	48.3%	56.6%
100	38.9%	45.3%
110	35.1%	40.6%

Source: Adapted from Theron (2013:24)

It was concluded that, through the interpretation of Table 3.5, the probabilities were 82.4% and 35.1% respectively that the living annuitant will be solvent until at least the ages of 80 and 110. The probabilities that the conventional annuitant will be solvent until at least the ages of 80 and 110 respectively were 91.1% and 40.6% (Theron, 2013:24).

Furthermore, the author also concluded that for all scenarios considered, the life annuity strategy outperformed the living annuity strategy in terms of the time to insolvency. Thus the conventional annuity was deemed the superior product if the decisions were based on the time to insolvency alone (Theron, 2013:25).

3.1.9 De Villiers-Strijdom (2013)

The study by De Villiers-Strijdom (2013:iv) is the only South African study to have analysed annuities by means of a historical approach. The present values of historic monthly cash flows provided by living, level, and 5% escalating annuities were calculated in determining which annuity would have yielded the greatest financial benefit to an annuitant with the benefit of hindsight. Furthermore, switching and composite strategies were also considered. Switching strategies consisted of living annuitants purchasing either a level or an escalating annuity ten years after retirement. Composite strategies consisted of annuitants purchasing both a living and a level, or an escalating annuity, with equal amounts invested in both.

A male retiree, with three possible retirement ages of 55, 60, and 65, was assumed to retire with R1 000 000 during each of the 30 years from 1960 to 1989. Life expectancy was assumed to follow the a(55) life mortality table. The annuitant could invest in any one of the following annuity strategies: a level or an escalating annuity, nine living annuity strategies, 18 composite annuity strategies, and 18 switching annuity strategies (De Villiers-Strijdom, 2013:1).

With regards to the living annuity, three asset allocations were modelled with equity and bonds assumed to be the only two investible asset classes. Aggressive, moderate, and conservative asset allocations were modelled, and initial drawdown rates were assumed to match those as prescribed by the Code on Living Annuities of the Life Offices Association of South Africa. The historic returns of the ALSI and ALBI were used as proxies for the equity and bond returns (De Villiers-Strijdom, 2013:35).

Three drawdown strategies were modelled. Firstly, the same percentage was maintained throughout. Secondly, the drawdown rate was adjusted each year to increase the Rand amount of income by 5% per annum. Thirdly, the drawdown rate was adjusted each year to increase the Rand amount of income by the annual historic inflation rate. All three strategies were subject to the legal drawdown limits (De Villiers-Strijdom, 2013:39).

Historical conventional annuity rates were computed by Sanlam actuaries. These rates determined the level and escalating annuity benefits. Historical inflation rates, as measured by the CPI of South Africa, were used in discounting the annuity benefits (De Villiers-Strijdom, 2013:37).

Irrespective of the retiree's age, pure living annuity results favoured aggressive asset allocation strategies combined with a drawdown strategy in which the Rand amount of income was annually increased by 5%. The worst performing strategies occurred if the annuitant maintained the same drawdown rate throughout and invested conservatively (De Villiers-Strijdom, 2013:69).

Composite annuity strategies indicated that the same living annuity strategies as mentioned above were superior. The best performing composite strategies consisted of level and living annuities with an aggressive asset allocation, and the worst performing strategies consisted of escalating and living annuities with a conservative asset allocation. Thus, in retrospect, retirees who purchased a living annuity together with a level annuity, would have been in a superior financial position to those who made the simultaneous purchase of a living and escalating annuity (De Villiers-Strijdom, 2013:82).

Similar results as to what was obtained for composite strategies were also obtained for switching strategies. The only difference was that the best performing strategy for a 65 year-old male retiree consisted of a living annuity where the drawdown rate was adjusted each year to increase the Rand amount of income by the annual inflation rate (De Villiers-Strijdom, 2013:90).

In comparing all the strategies with one another, pure living annuity strategies were superior to composite annuity strategies which, in turn, were superior to switching annuity strategies (De Villiers-Strijdom, 2013:101).

3.1.10 A Comparison of South African Annuity Research

This section provides a tabulated summary of what are, in the author's opinion, the four most thorough South African research studies. The presentation of South African literature in this form provides for easy identification of the differences between these studies, as well as which aspects future studies could investigate and expand on. All the aspects included in Table 3.6 have been discussed above, or are presented as an intuitive interpretation such as the initial retirement capital.

Table 3.6: Research Comparison

General Factors				
Factor	Goemans & Ncube	Levitan, <i>et al.</i>	Butler, <i>et al.</i>	De Villiers-Strijdom
Annuities Analysed	1) Living 2) Guaranteed a. Level b. 5% escalating c. With-profit	1) Living 2) Guaranteed a. Level b. 3% escalating c. Inflation-linked	1) Living 2) Guaranteed a. Level b. 5% escalating c. Inflation-linked	1) Living 2) Guaranteed a. Level b. 5% escalating
Annuity Options	Ten year guarantee period.	N/A	Ten year guarantee period and a 75% spouse's provision.	N/A
Approach	Forward-looking	Forward-looking	Forward-looking	Historical
Evaluation Criteria	1) Expected present value 2) Ruin	Ruin	1) Discounted utility 2) Ruin	Present value analysis
Inflation	Not modelled.	Stochastically modelled. Market neutral parameters as at 1 July 2009 were used.	Stochastically modelled with an average of 5.8% over a ten year period was built into the model.	Historic CPI figures were used.

Table 3.6: Research Comparison (Continued)

Fictitious Retiree Assumptions				
Factor	Goemans & Ncube	Levitan, <i>et al.</i>	Butler, <i>et al.</i>	De Villiers-Strijdom
Gender	Male	Male	As per Table 3.3	Male
Age	60	65	As per Table 3.3	55, 60, 65
Retirement Dates	31 December 2007	1 July 2009	N/A	Each of the 30 years from 1960 to 1989.
Mortality	SAIL98 Mortality table. An improvement of 1 year reduction for every 20 years projected was simulated.	Stochastically modelled with PA (90) table. Adjustments of 3 years downwards with a 1.5% p.a. mortality improvement.	PA (90) table rated down by 3 years for males and 2 years for females. A 1.5% p.a. mortality improvement as from 2012 onwards was used.	a(55) life mortality table
Initial Retirement Capital	R500 000	R1 000 000	R1 000 000	R1 000 000

Table 3.6: Research Comparison (Continued)

Living Annuity Assumptions												
Factor	Goemans & Ncube			Levitan, <i>et al.</i>			Butler, <i>et al.</i>			De Villiers-Strijdom		
Assets Modelled	Equity & Bonds			Equity & Bonds			Equity & Bonds			Equity & Bonds		
Asset Allocation	Number	Equity	Bonds	Number	Equity	Bonds	Number	Equity	Bonds	Number	Equity	Bonds
	1	100	0	1	75	25	1	75	25	1	75	25
	2	75	25	2	50	50	2	50	50	2	50	50
	3	50	50	3	25	75	3	25	75	3	25	75
	4	25	75	4	0	100	4	0	100	4	N/A	N/A
	5	0	100	5	N/A	N/A	5	N/A	N/A	5	N/A	N/A
Drawdown Strategy	1) Constant DD% 2) Same Rand amount 3) Growing Rand by 5%			Initial income increasing with inflation until cap is reached.			Initial income increasing with inflation until cap is reached.			1) Constant DD% 2) Growing Rand with inflation 3) Growing Rand by 5%		
Initial Drawdown Rates	2.5%, 5%, 7.5%, 10%, 12.5%, 15%, 17.5%			Various levels were tested.			Draw at the rate of income required for either comfort or necessities.			Based on age: 1) 55 = 5.5% 2) 60 = 6.2% 3) 65 = 7.3%		

Table 3.6: Research Comparison (Continued)

Factor	Fees			
	Goemans & Ncube	Levitan, <i>et al.</i>	Butler, <i>et al.</i>	De Villiers-Strijdom
Guaranteed Annuity	A reduction in yield % was applied	N/A	N/A	Initial commission of 1.71%
Living Annuity	1) Asset management fees: a. Equity = 1.3% p.a. b. Bonds = 0.9% p.a. 2) Advice: 0.57% p.a. 3) On-going expense: 0.25% p.a.	N/A	N/A	1) Asset management fees: a. Equity = 1.4% p.a. b. Bonds = 0.9% p.a. 2) Advice: 0.57% p.a. 3) On-going expense: 0.25% p.a.
With-Profit Annuity	1) Initial costs: a. Initial expense = R500 b. On-going expense charge capitalised upfront. 2) Yearly charges: 1.75% p.a. split between various categories	N/A	N/A	N/A
Inflation-Linked Annuity	N/A	N/A	N/A	N/A

Source: Author (2015)

3.2 International Research Studies

This section elaborates on international annuity-related research. A distinction is made between research that implemented utility and risk-return functions as it is argued that these two approaches represent the main underlying differences in earlier studies. Horneff, Maurer, Mitchell and Dus (2008:399) showed that only 15% of previous researchers made use of risk-return frameworks in their analyses. Both Milevsky (1998:403), and Dus, Maurer and Mitchell (2005:171) mention that there is a great deal of subjectivity involved in using discounted utility models, which leads to the question as to why so many researchers employ this model.

Nevertheless, most of these studies were published in highly rated academic journals and have been widely cited. Consequently, it is believed that they have added significant value to the annuity research field. Section 3.2.1 presents a number of the most notable past studies on utility based annuity research and Section 3.2.2 presents risk-return based research. Section 3.2.3 focusses on studies conducted after 2008.

3.2.1 International Utility-based Annuity Research

Yaari (1965:1) addressed the issue which previous studies neglected to include in their analyses. The study incorporated the uncertainty of survival as it was argued that when individuals plan for the future they make an allowance for the uncertainty of survival. The study thus modelled this uncertainty as a utility function while reducing the influence of other factors, such as future earnings, on an individual's expected utility. The author concluded that risk-averse retirees, who have no desire to leave any capital inheritance, should annuitise all of their wealth at retirement.

A study that was conducted ten years after Yaari (1965) implemented different assumptions, but came to the same conclusion. Richard (1975) generalised the result to a stochastic environment as opposed to the deterministic model assumed by Yaari (1965).

Horneff, *et al.* (2008:399) classified the study by Mitchell, Poterba, Warshawsky and Brown (1999) as a utility-based study. This researcher, however, argues that Mitchell, *et al.* (1999) can also be classified as a risk-return study due to the fact that the study calculated, apart from discounted utility, a Money's Worth Ratio (MWR). The MWR divides the present value of

life annuity benefits by the premium paid for the annuity. This was considered to be the centrepiece of the methodology (Mitchell, *et al.*, 1999:1302). In essence the MWR measures the financial value an annuitant receives in exchange for the upfront premium paid.

Mitchell, *et al.* (1999:1300) concluded, with regards to the MWR, that the annuitant incurred a significant *transaction cost* in purchasing a life annuity. The transaction cost was measured as the difference between the premium paid and the present value of the benefits received. This cost equalled between 15 and 20 cents per dollar of premium paid. The authors were in accord with previous studies in terms of the discounted utility results. It was concluded that a retiree would prefer to annuitise rather than to follow an optimal consumption strategy (Mitchell, *et al.*, 1999:1316).

With the development of annuity research, most studies focussed on determining whether or not it is worthwhile for retiring male or female individuals to purchase an annuity. Brown and Poterba (2000) analysed joint-and-survivorship annuities and the possible financial benefit these products held for married couples. The study included the effect of joint consumption, interdependent utilities, and correlated mortality rates in their analysis of discounted utility (Brown & Poterba, 2000:527).

The authors presented their results for a married couple consisting of a 65 year-old man and a 62 year-old woman who had access to an actuarially fair joint-and-survivorship annuity. Such an annuity implied that the insurance company would have zero expected profits. It was found that if the married couple did not have access to an actuarially fair joint-and-survivorship annuity, they would have required between 18% and 30% more wealth in order to have achieved the same level of utility as delivered by the fair annuity (Brown & Poterba, 2000:551).

Blake, Cairns and Dowd (2003:31) compared three distribution programmes available to a 65 year-old male retiree that resided in the U.K. These three programmes consisted of a life annuity, an equity-linked annuity (ELA) with a life annuity purchased at age 75, and an equity-linked income-drawdown (ELID) programme with a life annuity purchased at age 75.

The ELA product's underlying assets contained both equities and bonds. This product protects the annuitant from depleting the underlying assets prior to age 75 due to the fact that the annuity benefit falls in line with any decrease in the fund value. Five different asset allocations were modelled. Equity exposure of 0%, 25%, 50%, 75%, and 100% (with the

balance invested in bonds) were simulated. This product did not allow for a bequest motive. The ELID annuity, however, did allow for the residual capital to be bequeathed to the annuitant's estate should he have died before the age of 75 (Blake, *et al.*, 2003:31).

The authors concluded that the optimal strategy did not necessarily involve a bequest, i.e. the optimal strategy was fairly insensitive to the annuitant's bequest motive. The optimal strategy did, however, rely greatly on the annuitant's level of risk tolerance. It was also concluded that a life annuity would be the optimal strategy for a highly risk-averse annuitant. Similarly, the more risk tolerant the annuitant was assumed to be, the greater the equity exposure should have been – as would be expected (Blake, *et al.*, 2003:45).

Milevsky and Young (2003:ii) analysed the optimal annuitisation age for individuals with a stochastic time of death. The loss from annuitising prematurely was also determined. This was analysed as certain countries require individuals to fully annuitise at a specific age.

Contrasting results to those of previous studies were obtained. The authors concluded that even in the absence of a bequest motive there was an incentive to delay annuitisation. The youngest age at which it was deemed optimal to annuitise was 70. Required annuitisation prior to this age was determined to be to the retiree's disadvantage. Should the annuitant have had the option to annuitise in small portions at any time, the optimal solution was to first have annuitised a portion of the retirement capital, and to then have purchased additional life annuities should the overall level of wealth have increased (Milevsky & Young, 2003:27).

The study by Gerrard, Haberman and Vigna (2004:321) analysed an income drawdown option and attempted to establish an optimal investment strategy after retirement. The optimal strategy was based on a pensioner's desire to achieve a certain target at age 75, at which point it was assumed the retiree purchased a life annuity. Various risk tolerance levels of individuals were analysed through the adaptation of the utility function and no bequest motive was modelled. Certain risk-return parameters were also modelled.

The authors concluded that the probability of ruin, with ruin being defined as the underlying fund being depleted, varied between 2% and 11%. Although this was considered to be significantly low, the authors stressed the fact that a retiree could well be in a poorer financial position by opting for an income drawdown option which resulted in a ruin probability of between 25% and 33%. However, with this in mind the authors stated that if a retiree did not

have a risk aversion level that was too high, the income drawdown option should be superior to immediate annuitisation (Gerrard, *et al.*, 2004:340).

Horneff, *et al.* (2008:396) implemented a utility-based framework to compare phased withdrawal options with conventional annuities. The authors allowed for stochastic capital market returns, uncertain life expectancies, interest rate movements, and various levels of retiree risk aversion. They also tested whether it was beneficial to either utilise a combination of these products, or to switch from a phased withdrawal plan to a conventional annuity at a later stage in life.

Similar to Dus, *et al.* (2005:174), the authors applied four withdrawal strategies namely the fixed benefit, fixed percentage, $1/T$, and the $1/E(T)$ rule. The fixed benefit rule paid the same benefit as the conventional annuity would have; the fixed percentage rule paid a specific percentage of the underlying fund value; the $1/T$ rule paid a benefit according to the maximum duration of the plan – where T could, for example, be the oldest age someone is likely to reach; finally, the $1/E(T)$ rule took into account the remaining life expectancy of an individual and paid a benefit accordingly (Horneff, *et al.*, 2008:401).

The authors determined that the $1/T$ rule provided lower expected benefits until age 74 in comparison with the other strategies, but after age 74 the benefits paid by this strategy quickly escalated. The $1/E(T)$ was deemed superior to the $1/T$ rule up to the age of approximately 83. The expected payout of this strategy peaked at age 88 after which it quickly declined. The results were then measured based on a retiree's risk preference (Horneff, *et al.*, 2008:401).

Overall, the fixed percentage rule was determined to be superior largely due to the performance it delivered on a risk-preference basis. The $1/E(T)$ rule appealed to low to moderate risk-averse retirees, and the $1/T$ rule performed worst. The study also concluded that immediate annuitisation at retirement outperformed any deferment strategy if the retiree had a high risk aversion and lacked the desire to leave any inheritance. Finally, the authors indicated that retirees with a moderate to high level of risk aversion would have benefited from investing in a combined portfolio consisting of an annuity and a phased withdrawal strategy. With the combination strategy utilised, low to moderate risk-averse retirees' well-being increased by between 25% and 50% in comparison with full annuitisation at retirement (Horneff, *et al.*, 2008:406).

A study by Lockwood (2012:226) implemented a utility framework in an attempt to establish whether retirees' bequest motives can explain the low levels of annuitisation found in contemporary society. The author attempted to determine how strong the bequest motive of a retiree must be to completely eliminate the possible purchase of an annuity. It was concluded that only moderate bequest motives were necessary to eliminate the desire to purchase an available annuity. These levels were significantly lower than those needed to eliminate the desire to purchase actuarially fair annuities. Available annuities were deemed to be actuarially unfair annuities which led to the conclusion that retirees with bequest motives would not annuitise any wealth (Lockwood, 2012:238).

3.2.2 International Risk-Return-based Annuity Research

Milevsky (1998:403) employed a shortfall probability approach in analysing whether to fully annuitise, or to follow a self-annuitisation strategy, i.e. not to purchase an annuity, but attempt to replicate the payoff from a life annuity through an investment fund. The author argued that retirees mainly face three variables of uncertainty. These include investment returns, mortality, and interest rates. Subsequently, these variables were stochastically modelled based on historic Canadian data (Milevsky, 1998:409).

The study concluded that a 65 year-old female had a 90% chance of outperforming the return offered by a life annuity up to the age of 80. Similarly, a 65 year-old male had an 85% chance of outperforming the return offered by a life annuity up to the age of 80. It was also concluded that annuitisation would be opted for by males and females who, respectively, considered a 15% and 10% shortfall probability too high (Milevsky, 1998:424).

A study by Milevsky and Robinson (2000:112) computed a lifetime and eventual probability of ruin for an individual who was assumed to self-annuitise. The concept of self-annuitisation implies that the individual draws a fixed (real or nominal) amount from an underlying investment fund instead of purchasing a life annuity. The LPoR was defined as the probability that net wealth would entirely deplete, prior to a stochastic time of death. The eventual probability of ruin (EPoR) was defined as the probability that net wealth would eventually deplete for an individual who had an infinite lifespan. Equities, bonds, and risk-free (Treasury-bill) investments were simulated as investible assets and various asset allocations were also included in the study.

The wealth-to-consumption ratio was introduced to serve as a measurement of living standards. With a real wealth-to-consumption ratio of 14 assumed, the ruin probabilities for a 65 year-old male and female retiree were obtained and are presented in Table 3.7 (Milevsky & Robinson, 2000:122).

Table 3.7: Ruin Probabilities

Results						
Asset Allocation (%)			Male		Female	
Equity	Bonds	T-Bill	EPoR	LPoR	EPoR	LPoR
0	20	80	1	0.307	1	0.518
0	40	60	1	0.295	1	0.495
0	60	40	1	0.291	1	0.479
0	80	20	0.999	0.292	0.999	0.472
0	100	0	0.993	0.230	0.993	0.470
0	0	100	1	0.325	1	0.548
20	0	80	0.999	0.250	0.999	0.426
40	0	60	0.991	0.206	0.991	0.342
60	0	40	0.884	0.188	0.884	0.299
80	0	20	0.755	0.186	0.755	0.284
100	0	0	0.673	0.195	0.673	0.285
60	40	0	0.811	0.170	0.811	0.269
40	60	0	0.921	0.185	0.921	0.300
20	80	0	0.979	0.228	0.979	0.370
80	20	0	0.719	0.176	0.719	0.267
20	20	60	1	0.234	1	0.399
40	20	40	0.981	0.193	0.981	0.319
60	20	20	0.849	0.177	0.849	0.281
20	40	40	0.999	0.225	0.999	0.380
40	40	20	0.957	0.186	0.957	0.306
20	60	20	0.996	0.223	0.996	0.371

Source: Adapted from Milevsky and Robinson (2000:122)

Table 3.7 shows that the lowest LPoR for a female retiree occurred at an asset allocation of 80% equities and 20% bonds. This yielded a ruin probability of 26.7%, i.e. the likelihood of the retiree not being able to sustain her living standards for the remainder of her life was equal to 26.7%. A male retiree with a portfolio invested 60% in equities and 40% in bonds had the lowest ruin probability of 17%. The results suggested that a retiree who considered self-annuitisation should diversify the underlying investments (Milevsky & Robinson, 2000:122).

A German study by Albrecht and Maurer (2002) also analysed self-annuitisation by assuming that a retiree (aged 60, 65, or 70) invested in a mutual fund at retirement and made subsequent withdrawals from the fund. Equities, bonds, and real estate investments were considered. The benefit that would have been paid to the retiree by a life annuity was set to be the withdrawal amount. The main objective of the paper was to determine the asset allocation of the mutual fund which minimised the probability of depleting the investment fund before an uncertain date of death (Albrecht & Maurer, 2002:270).

The results indicated that a 60 year-old retiree should allocate most of his capital to real estate, and the least to bonds. A 65 year-old should invest most in equities, and the least in bonds. A 70 year-old should invest the most in equities, and the least in real estate (Albrecht & Maurer, 2002:279). With regards to shortfall probabilities the authors concluded that self-annuitisation strategies posed a substantial risk that retirees would outlive their retirement capital (Albrecht & Maurer, 2002:284).

A second German study by Dus, *et al.* (2005:169) compared alternative phased withdrawal strategies with a (real) life annuity. The authors made the comparison on a shortfall probability basis and discounted three factors in analysing the retirement income options. These three factors were as follows: the level of shortfall, the benefit to be received, and the possible bequest amount.

Four withdrawal strategies were analysed. Firstly, a fixed benefit strategy, with the benefit set to match the fixed income which would have been received by a life annuity, was analysed. The second strategy considered was phased withdrawal plans with variable benefits which included a fixed percentage withdrawal plan and a $1/T$ withdrawal plan. A constant fraction was withdrawn each period under the fixed percentage withdrawal plan. The $1/T$ plan set the withdrawal fraction equal to the maximum possible duration of the plan, i.e. either the oldest age assumed in the mortality table or an assumed fixed life expectancy as at the annuitant's retirement date. The fourth plan, called the $1/E[T(x)]$ withdrawal rule, took into account the pensioner's life expectancy (Dus, *et al.*, 2005:174).

Of these phased withdrawal strategies neither was superior to the other for a 65 year-old male or female retiree. However, the $1/E[T(x)]$ rule did outperform the others, given that the retiree accepted a moderate bequest appetite (Dus, *et al.*, 2005:183). In contrast with previous research, the results indicated that a phased withdrawal plan which minimised the risk of

consuming less than the real annuity benchmark allocated more to fixed income investments than to equities (Dus, *et al.*, 2005:189).

Milevsky, Moore and Young (2006:647) set the objectives of determining the optimal investment and annuitisation strategies for a retiree whose sole desire was to minimise the probability of lifetime ruin. Ruin was defined as the retiree's wealth entirely depleting after drawing a fixed level of consumption throughout her life. The authors concluded that as a retiree's wealth increased, the level of equity exposure should also increase. Though the paper was presented with a technical and mathematical background, the authors also concluded with some practical examples. For instance, should a retiree wish to have a very low probability of ruin of only 5%, a wealth level of at least 15.55 times the desired consumption was required (Milevsky, *et al.*, 2006:661).

3.2.3 Post 2008 Annuity Research

Annuity research post 2008 appear to take a much narrower approach in analysing post-retirement income strategies. For example, most of the studies include recent developments in international annuity markets, such as newly introduced annuity products. Other studies use significantly different approaches in analysing income strategies. What follows are brief references to some of these studies.

Emms (2010:176) analysed income drawdown from a DC pension fund by means of linear-quadratic optimisation. The optimal investment strategy and drawdown were determined by implementing this optimisation function. The author also attempted to minimise the deviation from prescribed targets for both the underlying fund and the drawdown value. Furthermore, a non-dimensionalising function was included in the analysis which allowed the retiree to make relative choices between the fund size, income drawdown, the terminal annuity rate, and the bequest motive (Emms, 2010:196).

The author concluded that for a risk tolerant pensioner, an internal rate of return target should be followed as this smoothed consumption over the pensioner's lifetime. A risk-averse pensioner should follow an annuity target, i.e. draw down the same amount as would have been acquired through the purchase of a conventional level annuity (Emms, 2010:196).

Gong and Webb (2010:210) analysed Advanced Life Deferred annuities (ALDA) by means of numerical optimisation. This product is relatively new in the U.S. and is offered by only a few life companies. The product caters for people who wish to purchase protection against the depletion of their capital at a very late stage in life (80 to 85 years of age). Typically, retirees would purchase this deferred annuity at the age of 60 with between 10% and 25% of their accumulated pension capital. The longevity risk they face at a later stage in life is then mitigated as the annuity pays a fixed benefit in nominal terms, starting at this older age (Gong & Webb, 2010: 211).

The authors compared an inflation-protected ALDA, which they modelled themselves, as no life company sells an inflation-protected version of this product, with the following three strategies: an immediate inflation-protected annuity which starts paying benefits at retirement, voluntarily deferring the purchase of an annuity until a later stage in life, and following an optimal decumulation of lifetime savings (Gong & Webb, 2010: 210).

The conclusion was made that the ALDA provides three distinct advantages. Firstly, retirees have the benefit of liquidity well into retirement as the purchase cost of an ALDA is a fraction of the cost of an immediate annuity. Secondly, an ALDA is deemed superior to that of full, immediate, annuitisation based on plausible projected levels of actuarial unfairness. And thirdly, an ALDA has the potential to provide a simplified wealth decumulation strategy in the post-retirement phase, prior to the commencement of the ALDA, through implementing simple rule-of-thumb drawdown schemes (Gong & Webb, 2010: 211).

A study by Mahayni and Schneider (2012:2417) analysed U.S. variable annuities with an additional GMAB option incorporated. Section 2.3.3 of this study explained the different guarantee options available. In essence, the product guarantees a minimum terminal level of wealth whilst providing the annuitant with an option to participate in the underlying investment allocation decision.

The authors concluded that the annuitant achieves a significant level of utility by being involved in the *dynamic* asset allocation decision, i.e. the decision is a continuous process. This flexibility is likely to outweigh the losses incurred due to the guaranteed option possibly being priced too high as the insurer takes into account the most risky strategy selectable by the investor. However, if the annuitant is not able to adjust the investment strategy, i.e. a *static* strategy is followed, the purchase of such an annuity is not likely to hold any value (Mahayni & Schneider, 2012:2427).

Wang and Young (2012:200) proposed a new product to address the issue of why so many retirees are reluctant to purchase life annuities. The authors argued that an annuity which offered a surrender option would have more appeal to retirees. In other words, should a retiree be able to opt out of the life annuity at any time and receive a specific capital amount, the demand for annuities should increase.

The surrender option could be exercised through either borrowing against or surrendering any portion of the annuity during the annuitant's lifetime. The surrender value was set to be equal to the purchase value less a proportional surrender fee. It was assumed that the retiree had an exogenous spending level and that based on this, a lifetime ruin probability could be calculated. Ruin was defined as the retiree's wealth entirely depleting while still alive (Wang & Young, 2012:201).

The optimal annuity purchase and surrender charge strategies as well as the optimal investment strategy, with a risky and risk-free asset being modelled, were determined. It was concluded that if the surrender fee was significant, an annuitant would not purchase a life annuity unless it covered all of the annuitant's expenses. However, the pensioner would partially annuitise if the surrender charge was deemed small enough by the annuitant. Furthermore, it was concluded that the surrender fee level at which an individual might consider to purchase the proposed annuity, might be too low for annuity providers so as to be a profitable product for them (Wang & Young, 2012:213).

The study by Brown and Warshawsky (2013:677) integrated life annuities with long-term care insurance coverage. The study combined the challenges faced by each of these two markets and attempted to find a harmonised solution. Immediate life annuities are subject to low demand due to individuals with low life expectancies not being as likely to purchase these products which, in turn, lead to higher annuity prices, i.e. lower annuity benefits payable by life companies. The long-term care insurance coverage suffers from the fact that a large portion of the population are being rejected by underwriting standards due to ill health or poor lifestyles and thus lower life expectancies (Brown & Warshawsky, 2013:677).

The authors made use of the Health and Retirement Study which contains data on individuals in retirement and their disability incidence. The study put forward the objective of establishing whether or not underwriting can be introduced on a more extensive basis to the life annuity market, and vice versa (Brown & Warshawsky, 2013:678).

The authors presented evidence that a product combining these two fields could well succeed in having individuals qualify for long-term care insurance who do not currently qualify. This could potentially be achieved through pooling risks via the annuity market. This should in turn also provide more affordable life annuities to the market (Brown & Warshawsky, 2013:679).

Horneff, Maurer, Mitchell and Rogalla (2013:22) analysed GMWB variable annuities and showed the increased utility these products offer. These products were also discussed in Section 2.3.3. The results of the study differed significantly from previous research in that the authors suggested that measurable amounts of GMWBs should be purchased long before retirement, whereas other studies suggested that pensioners will postpone purchasing deferred annuities (Horneff, *et al.*, 2013:22).

Finally, a recent study by Huang, Milevsky and Salisbury (2013:ii) analysed U.S. variable annuities with a GLWB purchased as an additional option based on an American option pricing framework. The authors analysed the optimal age at which a pensioner should initiate the guaranteed lifetime income payments. They concluded that pensioners should start taking income from this product in their late 50's or early 60's.

3.3 Conclusion

Chapter Three provided an overview of both national and international annuity-based research studies. The studies were presented in chronological order but the international studies were first divided into utility and risk-return sections. The international studies provide a clear distinction between these two study areas whereas the South African studies mainly follow a risk-return analysis alone.

The most important results from each of the studies were highlighted and presented. The South African research was dealt with in more detail due to the uniqueness of the South African annuity market as well as the fact that this thesis focusses solely on South African annuities.

Chapter 4

Research Methodology

Chapter four describes the methodology followed in the study. The chapter is structured into several sections. It is advised that the reader consults Chapter One and familiarises himself with the *Overview of the Study* section before continuing with this chapter. The data collection process is explained in Section 4.1 after which the methodology of return simulations is discussed. The calculations of annuities and the subsequent analysis thereof are discussed in Section 4.3.

4.1 Simulating Investment Returns

4.1.1 Collecting Historic Data

The investment returns for the asset classes mentioned before were all based on historic data (until 2013) and the underlying statistics from these classes. All the historic returns obtained were total returns, i.e. with investment income reinvested, and measured in South African Rand (ZAR). This was done in order to ensure continuity amongst returns and to nullify any exchange rate risk. The returns were also lognormal returns as these were required for the return simulations. The choices of which indices were to be used as investable proxies and the collection of historical data are elaborated on next.

4.1.1.1 Local Equity, Local Bonds, and CPI

Firer and McLeod (1999) constructed a comprehensive database, starting in January 1960, containing the monthly index values of the JSE All Share and All Bond Index. The inflation rate, measured by monthly increases in the CPI, was also included in this database for the same time period. The database was kept up to date by the authors until 2010. This dataset is considered the best representation of the two major South African indices. It is also included in the Dimson, Marsh and Staunton (2002) database.

Data post 2010 was collected from the INET BFA Database (2015). Data prior to 2010 was also collected from the INET database and was contrasted to that of Firer and McLeod (1999). No significant differences could be found.

4.1.1.2 JSE Top 40 Index

The TCPP annuity invests in the ALBI and JSE Top 40 indices as was explained in Chapter 2. Thus, in order to simulate future income streams for this product the investment returns for the Top 40 Index also had to be simulated. The Top 40 Index contains the largest 40 companies listed on the JSE based on market capitalisation.

Data from 1960 onwards was obtained from Sanlam. It should be noted that the index itself is relatively new and no data consequently exists that dates back to 1960. However, a fictitious index was constructed by adding a historic monthly outperformance figure relative to the ALSI (around 0.2%) to the ALSI return itself.

The actual index returns were used from July 1995 onwards. The Sanlam database covers the period up to December 2012 and returns post 2012 were obtained from the INET BFA Database (2015).

4.1.1.3 Local Property

Living annuitants are also allowed to invest in the property market. For this reason property was also introduced as an investable asset class in this study. The J255 Total Return Index is South Africa's oldest property unit trust and was subsequently used as a proxy for property investments by annuitants. Returns for the index were jointly obtained from Towers Watson and the JSE research department and date back to February 1976.

4.1.1.4 International Equity

International, or offshore investments, also offer living annuitants a diverse range of equity and bond exposure. To simulate an investable offshore equity asset class it was first necessary to select an appropriate proxy. The Morgan Stanley Capital International (MSCI) MXWO

Index fulfilled all the requirements for a proxy as the index only measures developed markets' performance. It also has a long history with data dating back to January 1971. The returns were obtained from Bloomberg and it was ensured that it was denominated in ZAR.

4.1.1.5 International Bonds

Living annuitants may also invest in offshore bonds. Data for an international bond proxy, unfortunately, did not have as long a history. The JP Morgan Global Bond Index was decided on as a proxy for international bonds as it too only covers developed markets. Monthly returns, measured in ZAR, were obtained from Towers Watson dating back to January 1986.

4.2 Generating Investment Returns

A new database was constructed with the historic data collected. This database contained all the returns for the dates mentioned in Section 4.1. However, in view of the fact that the forecasting of asset returns was based on the underlying statistics of the database, such as correlations, the database had to have a homogenous starting and ending date. In other words, the number of investment returns had to be equal for all asset classes. Subsequently, the database started at January 1986, the earliest date for which all asset classes' returns could be obtained, and ended at December 2013. This database included 336 monthly returns for six asset classes as well as monthly inflation. All calculations were conducted in Microsoft Excel 2013. The following sections elaborate on the investment return simulation process followed in this study.

4.2.1 Frequency Distributions

An intuitive statistical process was followed in simulating the returns for each asset class. This process is best explained with a numerical example. Firstly, a frequency distribution was created for each asset class. Table 4.1 depicts an extract from the distribution for the ALSI asset class.

Table 4.1: ALSI Frequency Distribution

ALSI						
I #	Intervals	Frequency	Relative	R #	Random	Return
1	-35.20%	1	0.003	1	0.518706527	1.90%
2	-34.86%	1	0.003	2	0.695859106	4.31%
⋮	⋮	⋮	⋮	⋮	⋮	⋮
106	0.53%	139	0.414	106	0.229907694	-2.56%
107	0.87%	149	0.443	107	0.312315836	-1.19%
⋮	⋮	⋮	⋮	⋮	⋮	⋮
150	16.33%	336	1	150	0.753694486	5.00%
				⋮	⋮	⋮
				1000	0.68545493	3.97%

Source: Author (2015)

Each column in Table 4.1 is now explained. Column *I#* numbers the intervals in the frequency distribution from 1 to 150. In total the ALSI distributions were divided into 150 intervals. Column *Intervals* is a range of percentages structured around the lowest and highest monthly return for the asset class. Bins (differences between intervals) were set at 0.34% which allowed for 150 intervals. Interval 1, which equals -35.2%, is the lowest observation in the ALSI database and interval 150 is the highest. *Frequency* counts the number of observations that are equal to or below a specific interval. For example, there are 139 observations which are equal to or below the 106th interval (which is equal to 0.53%). Column *Relative* divides the specific frequency by 336 (the total number of observations in the sample). The 106th interval's relative frequency is equal to 0.414 (139 divided by 336). Column *R#* is merely presented here for ease of understanding. This column indicates that there are 1 000 random numbers to be generated. *Random* is a random number, between 0 and 1, generated by Excel. The column *Return* looks up the random number generated in column *Relative* and returns the corresponding return from *Intervals*. For example, the first random number that was generated by Excel for the ALSI was equal to 0.518. In the *Relative* column this random number corresponds to interval 1.90% and this return is subsequently returned. This process was repeated for each of the six asset classes as well as for CPI.

4.2.2 Calculating the Statistics

Certain statistics were required in order to complete the simulations. These included monthly standard deviations, correlations, and a Cholesky decomposition.

Monthly standard deviations could be obtained by dividing the annualised standard deviations by the square root of 12. A correlation matrix was also easily obtainable through the use of Excel's correlation matrix function. Table 4.2 depicts the standard deviations as well as the correlation matrix for the asset classes.

Table 4.2: Statistics

Standard Deviation							
	ALSI	ALBI	Top40	SA Property	Int. Equity	Int. Bonds	CPI
Annual	20.09%	8.35%	20.78%	16.65%	17.42%	14.08%	1.96%
Monthly	5.80%	2.41%	6.00%	4.81%	5.03%	4.06%	0.57%
Correlation Matrix							
	ALSI	ALBI	Top40	SA Property	Int. Equity	Int. Bonds	CPI
ALSI	1.00	-	-	-	-	-	-
ALBI	0.28	1.00	-	-	-	-	-
Top40	0.99	0.26	1.00	-	-	-	-
SA Property	0.29	0.36	0.26	1.00	-	-	-
Int. Equity	0.44	-0.09	0.45	0.01	1.00	-	-
Int. Bonds	-0.11	-0.23	-0.09	-0.25	0.51	1.00	-
CPI	0.00	-0.01	0.01	-0.10	-0.06	-0.08	1.00

Source: Author (2015)

The correlations between asset classes were taken into account by means of a Cholesky decomposition. This decomposition allows for the simultaneous forecasting of returns while taking into account the correlations between each variable. The Excel code on which the decomposition is based can be found in Appendix A. The results from the decomposition are presented in Table 4.3. The application of this table is discussed in Section 4.2.3.

Table 4.3: Cholesky Decomposition

Cholesky Decomposition							
	ALSI	ALBI	Top40	SA Property	Int. Equity	Int. Bonds	CPI
ALSI	0.058	-	-	-	-	-	-
ALBI	0.007	0.023	-	-	-	-	-
Top40	0.060	-0.001	0.007	-	-	-	-
SA Property	0.014	0.014	-0.008	0.043	-	-	-
Int. Equity	0.022	-0.012	0.004	-0.002	0.043	-	-
Int. Bonds	-0.005	-0.008	0.004	-0.006	0.024	0.031	-
CPI	0.000	0.000	0.000	-0.001	0.000	0.000	0.006

Source: Author (2015)

4.2.3 Calculating Dependent Returns

After the frequency distributions were constructed and the individual independent returns were derived it was necessary to standardise the values. This was done by subtracting the mean from the observation and dividing by the standard deviation. Formula 4.1 depicts this mathematically and a numerical example follows.

$$Z = \frac{x - \mu}{\sigma} \quad (\text{Formula 4.1})$$

with:

x = (random) observation

μ = average of 1 000 random return observations

σ = historical monthly standard deviation

Table 4.4 contains an extract of 10 out of 1 000 results, which also is the case in Tables 4.5 and 4.6. For example, in the case of Table 4.4 the first observation for the ALSI was computed as follows:

$$-0.633 = \frac{-2.56\% - 1.11\%}{5.80\%}$$

-2.56% is a random return generated by Excel and for all intents and purposes came from the *Return* column in Table 4.1. If the same iteration was used in this example as in the description of Table 4.1 the random return of -2.56% would have been 1.90%. The average of the 1 000 random returns generated in this particular iteration is equal to -1.11% and is subtracted from -2.56%. The historical monthly standard deviation of the ALSI asset class is equal to 5.80% and is used as the denominator in the formula.

Table 4.4: Independent Returns

Independent Returns N(0,1)							
#	ALSI	ALBI	Top40	SA Property	Int. Equity	Int. Bonds	CPI
1	-0.633	-0.243	-1.202	0.063	0.267	-0.368	0.288
2	1.144	-0.134	-0.421	-2.413	-1.356	0.963	0.177
3	1.914	0.410	-1.202	-0.229	0.498	1.354	0.399
4	-0.693	-0.569	0.471	0.645	0.421	-0.446	1.508
5	-0.456	0.519	-2.038	0.208	1.039	1.276	-0.709
6	-0.278	0.628	1.195	-1.539	-0.197	0.102	0.843
7	0.196	-0.025	-0.198	1.883	0.112	0.102	-1.374
8	-0.870	0.302	-1.258	-0.593	0.498	0.023	-0.599
9	0.314	1.282	0.136	0.281	0.576	1.980	1.397
10	0.077	-0.787	0.025	-0.083	0.344	1.041	0.953

Source: Author (2015)

With the standardisation of the independent returns complete it was then necessary to incorporate the figures obtained in the Cholesky matrix so as to derive the dependent returns. This was done by making use of matrix multiplication. The matrix below is an algebraic visualisation of how matrix multiplication works when a 3 x 3 matrix is multiplied with a 3 x 1 matrix. For the Excel calculations that were conducted 7 x 7 (the Cholesky table) and 7 x 1 000 (the independent returns table) matrices were used. The first three figures in the first row of Table 4.5 are used as a numerical example to illustrate these calculations.

$$\begin{bmatrix} a & b & c \\ d & e & f \\ g & h & i \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} ax + by + cz \\ dx + ey + fz \\ gx + hy + iz \end{bmatrix}$$

Example:

$$(0.058) \times (-0.633) = -0.037$$

$$(0.007) \times (-0.633) + (0.023) \times (-0.243) = -0.01$$

$$(0.06) \times (-0.633) + (-0.001) \times (-0.243) + (0.007) \times (-1.202) = -0.046$$

Table 4.5: Dependent Returns

Dependent Returns N(0,vol)							
#	ALSI	ALBI	Top40	SA Property	Int. Equity	Int. Bonds	CPI
1	-0.037	-0.010	-0.046	0.000	-0.004	-0.005	0.001
2	0.066	0.005	0.065	-0.086	-0.028	0.007	0.002
3	0.111	0.023	0.105	0.032	0.056	0.037	0.001
4	-0.040	-0.018	-0.037	0.006	0.010	0.002	0.008
5	-0.026	0.009	-0.042	0.026	0.021	0.051	-0.006
6	-0.016	0.013	-0.009	-0.071	-0.014	0.009	0.006
7	0.011	0.001	0.010	0.085	0.005	-0.008	-0.009
8	-0.050	0.001	-0.061	-0.023	-0.005	0.012	-0.004
9	0.018	0.032	0.018	0.034	0.017	0.061	0.007
10	0.004	-0.018	0.006	-0.014	0.026	0.047	0.005

Source: Author (2015)

The final step in calculating the dependent returns was to add the mean of each respective asset class back to the figures obtained in Table 4.5. For example the first randomly generated return for the ALSI in Table 4.6 is equal to -2.56% which is calculated by adding -3.674% (from Table 4.5) to the overall mean of 1.11%.

Table 4.6: Dependent Returns

Dependent Returns							
#	ALSI	ALBI	Top40	SA Property	Int. Equity	Int. Bonds	CPI
1	-2.56%	0.10%	-3.44%	0.94%	0.17%	0.41%	0.74%
2	7.74%	1.56%	7.67%	-7.69%	-2.16%	1.65%	0.86%
3	12.21%	3.34%	11.66%	4.17%	6.18%	4.70%	0.74%
4	-2.91%	-0.69%	-2.61%	1.58%	1.56%	1.18%	1.44%
5	-1.53%	1.98%	-3.04%	3.56%	2.70%	6.11%	0.04%
6	-0.50%	2.36%	0.21%	-6.11%	-0.81%	1.88%	1.21%
7	2.25%	1.17%	2.16%	9.45%	1.05%	0.19%	-0.27%
8	-3.94%	1.20%	-4.95%	-1.39%	0.15%	2.20%	0.25%
9	2.93%	4.27%	2.94%	4.32%	2.30%	7.04%	1.27%
10	1.56%	-0.67%	1.70%	-0.44%	3.20%	5.66%	1.10%

Source: Author (2015)

This process of generating returns was repeated 1 000 times for 480 months (40 years) and for six asset classes as well as inflation, resulting in 3 360 000 different percentages which are all correlated according to the statistics presented in Tables 4.2 and 4.3.

4.3 Calculating Present Values

The purpose of this study is to provide a better understanding of the value South African annuities offer retirees. Five different annuities were therefore compared based on a present value and ruin probability analysis. This section discusses how the present values were obtained for each annuity.

4.3.1 Living Annuity

The assumptions made in this study resulted in 96 000 different living annuity present values that were calculated. This figure is obtained from four asset allocations, three initial drawdown rates, one drawdown strategy, eight retiree scenarios and 1 000 return iterations. The assumptions are elaborated on next.

4.3.1.1 Asset Allocation

For each of the retiree scenarios in Table 1.1 it was assumed that they could invest in each of four asset allocations (AA). These allocations are depicted in Table 4.7 below.

Table 4.7: Asset Allocations

Asset Allocation	1	2	3	4
Bonds				
Local Bonds (ALBI)	5.00%	20.00%	30.00%	45.00%
International Bonds	5.00%	5.00%	10.00%	15.00%
Total Bonds	10.00%	25.00%	40.00%	60.00%
Equities				
Local Equity (ALSI)	55.00%	40.00%	35.00%	25.00%
International Equity	20.00%	20.00%	15.00%	10.00%
Total Equity	75.00%	60.00%	50.00%	35.00%
Property				
Local Property	15.00%	15.00%	10.00%	5.00%
Total Assets	100.00%	100.00%	100.00%	100.00%

Source: Author (2015)

The asset allocations range from aggressive to conservative. The first allocation (AA1) is the most aggressive with a total equity allocation of 75%. The total equity allocation consists of 73.33% local equities and 26.67% international equities. Local and international equities therefore make up 55% and 20% of the *total* portfolio, respectively. The total bond allocation is equally weighted between local and international bonds and contributes 10% to the total portfolio. This leaves 15% to be invested in local property. All three other allocations are structured in similar fashion but become more conservative, i.e. less equity and property investments and more bonds.

4.3.1.2 Fees

Although living annuities have become popular retirement products they are nevertheless criticised for having expensive fee structures. Table 4.8 depicts the living annuity fees that were applied in this study. The Net Fee Factor (NFF) is explained and included in Section 4.3.1.5

Table 4.8: Living Annuity Fees

Fees	ALSI	ALBI	Top40	Local Property	Int. Equity	Int. Bonds
Asset management	1.70%	0.80%	1.00%	1.44%	2.24%	2.25%
Adviser's fee	0.60%	0.60%	0.60%	0.60%	0.60%	0.60%
LISP fee	0.25%	0.25%	0.25%	0.25%	0.25%	0.25%
NFF	97.45%	98.35%	98.15%	97.71%	96.91%	96.90%

Source: Author (2015)

Asset management fees were calculated based on an average of prevailing market fees of similar investments. Table 4.9 shows how these percentages were derived. The individual asset management fees in the table are total expense ratios and were obtained from the company websites.

Table 4.9: Asset Management Fees

Company	Funds				
	ALSI	ALBI	Local Property	Int. Equity	Int. Bonds
Sanlam	1.42%	0.87%	1.45%	2.06%	2.40%
Old Mutual	1.55%	0.89%	1.44%	2.08%	2.09%
Coronation	1.63%	0.87%	1.43%	2.41%	-
Allan Gray	2.18%	0.52%	-	2.40%	-
Average	1.70%	0.79%	1.44%	2.24%	2.25%

Source: Author (2015)

Apart from the asset management fee an annual adviser's fee (0.6%) as well as an annual service fee (0.25%) were also debited against the investment. This is in accordance with De Villiers-Strijdom (2013:39) and Goemans and Ncube (2008:24).

Fees are deemed to be a significant aspect of living annuities as typical fee structures on a R1 000 000 living annuity product could cost the annuitant approximately R25 000 per annum. The underlying investment fund subsequently has to deliver a 2.5% annual return to break even.

4.3.1.3 Initial Drawdown

None of the previous South African annuity studies could support drawdown rates higher than 7.5%. Goemans and Ncube (2008:33) concluded that a maximum 7.5% drawdown rate might be sustainable. Beinash (2007:19) concluded that a maximum drawdown rate of 5% is sustainable. For this reason only three initial drawdown strategies were tested: 2.5%, 5% and 7.5%. It was deemed unnecessary to test for higher initial drawdown rates as previous studies already proved this to be a non-sustainable option.

4.3.1.4 Drawdown Strategy

One direct and four indirect drawdown strategies were followed in this study. The direct strategy annually increased the initial Rand amount by the simulated inflation. This would ultimately provide an indication of whether or not living annuity portfolios could sustain retirees on a real basis.

Indirect strategies were also tested during ruin probability calculations. A living annuity was constructed based on the payment profile of each of the four guaranteed annuities. This entailed using the monthly annuities paid by each of the four guaranteed products as a substitute in the living annuity product itself. Ultimately, this tested whether or not a living annuity portfolio could sustain the annuities paid by the guaranteed annuities.

4.3.1.5 Numerical Example

This section contains a detailed numerical example of how the living annuity present values were obtained. The section follows the structure as put forth by De Villiers-Strijdom (2013) with permission from the author. The investment procedure for retiree case number 1 is presented for a two year period in Table 4.10.

Table 4.10: Numerical Example

Background	Example
For each of the retirees in cases 1 to 8 in Table 4.1 a retirement date of 1 January 2015 and R1 000 000 in retirement capital is assumed.	
Retiree Case	1
Date of death: The annuity will continue to make payments for the number of years specified in Table 4.1.	21 years from now
Asset Allocation: Each of the four in Table 4.8.	Aggressive (AA1)
Initial drawdown rate: Each of the three drawdown rates stipulated.	2.5%
Drawdown strategy	Increases by the previous year's inflation
Cost	Example
Asset management fees:	
Local equities (ALSI)	1.7%
Local bonds (ALBI)	0.8%
Local property (J255)	1.44%
International equity (MXWO)	2.24%
International bonds (JPGBI)	2.25%
Adviser's fee (incl. VAT):	0.6%
Service fee (incl. VAT):	0.25%
Net fee factor (NFF) for:	
Local equities (ALSI)	97.45%
Local bonds (ALBI)	98.38%
Local property (J255)	97.71%
International equity (MXWO)	96.91%
International bonds (JPGBI)	96.90%
The NFF equals 1 minus the sum of the fees applicable to each specific asset class. The costs are deducted from the portfolio at the end of each year directly after the last annuity payment has been made. Costs are deducted before the portfolio is rebalanced.	

Table 4.10: Numerical Example (continued)

Investment Process at the End of Month 1	Example (continued)
Section 4.3 described the process of simulating the returns for the different asset classes. One of the iterations generated is used as an example to illustrate how the annuity payments are calculated.	
Each asset portion of the portfolio is increased on a monthly basis by the simulated return*:	$\text{Portfolio value} \times AA\% \times (1 + \text{Return}_{\text{Asset}}\%)$
ALSI	$R1\,000\,000 \times 55\% \times (1 + 3.28\%) = R568\,028.99$
ALBI	$R1\,000\,000 \times 5\% \times (1 + 4.06\%) = R52\,031.29$
J255	$R1\,000\,000 \times 15\% \times (1 + 8.35\%) = R162\,527.40$
MXWO	$R1\,000\,000 \times 20\% \times (1 + 4.34\%) = R208\,681.06$
JPGBI	$R1\,000\,000 \times 5\% \times (1 + 4.40\%) = R52\,198.06$
The calculation of the first <i>monthly</i> annuity payable is intuitive. At a 2.5% initial drawdown the first annuity would equal R2 083.33.	$R1\,000\,000 \times \frac{2.5\%}{12} = R2\,083.33$
The relevant monthly annuity amount is then deducted from each asset class. This process is repeated for each month of the year*:	$\text{Portfolio portion value} - (\text{Annuity} \times AA\%)$
ALSI	$R568\,028.99 - (R2\,083.33 \times 55\%) = R566\,883.16$
ALBI	$R52\,031.29 - (R2\,083.33 \times 5\%) = R51\,927.13$
J255	$R162\,527.40 - (R2\,083.33 \times 15\%) = R162\,214.90$
MXWO	$R208\,681.06 - (R2\,083.33 \times 20\%) = R208\,264.39$
JPGBI	$R52\,198.06 - (R2\,083.33 \times 5\%) = R52\,093.90$

Table 4.10: Numerical Example (continued)

Investment Process at the End of Year 1	Example	#
Deducting fees at year-end (December): The NFF is used in this calculation*.	$[Portfolio\ portion\ value - (Annuity \times AA\%)] \times NFF_{Asset\ class}$	
ALSI	$[R582\ 129.74 - (R2\ 083.33 \times 55\%)] \times 97.45\% = R566\ 168.81$	1
ALBI	$[R63\ 358.96 - (R2\ 083.33 \times 5\%)] \times 98.35\% = R62\ 211.08$	2
J255	$[R187\ 343.69 - (R2\ 083.33 \times 15\%)] \times 97.71\% = R182\ 748.17$	3
MXWO	$[R206\ 979.64 - (R2\ 083.33 \times 20\%)] \times 96.91\% = R200\ 180.18$	4
JPGBI	$[R56\ 296.07 - (R2\ 083.33 \times 5\%)] \times 96.90\% = R54\ 449.95$	5
Rebalancing the portfolio at year-end (December): All the values from # 1 to 5 are added together at year-end. The total amount is then rebalanced according to the asset allocation.	$\sum Portfolio\ value_{Asset\ x} \times AA\%$ $R566\ 168.81 + R62\ 211.08 + R182\ 748.17 + R200\ 180.18 + R54\ 449.95 = R1\ 065\ 758.20$	
ALSI	$R1\ 065\ 758.20 \times 55\% = R586\ 167.01$	
ALBI	$R1\ 065\ 758.20 \times 5\% = R53\ 287.91$	
J255	$R1\ 065\ 758.20 \times 15\% = R159\ 863.73$	
MXWO	$R1\ 065\ 758.20 \times 20\% = R213\ 151.64$	
JPGBI	$R1\ 065\ 758.20 \times 5\% = R53\ 287.91$	

*Differences due to rounding

Table 4.10: Numerical Example (continued)

Investment Process at the End of Month 13	Example
The investment process repeats itself in the second year again and only the calculation of the annuity differs.	
The calculation of the thirteenth <i>monthly</i> annuity payable is as follows: First the previous year's (yearly) simulated inflation has to be calculated.	<p>Inflation was treated as an asset class and simulated along with the six other asset classes. Monthly CPI percentages were subsequently simulated.</p> <p>The geometric average of the monthly inflation is calculated so as to provide a yearly inflation percentage.</p>
Inflation	$Inflation_{Yearly} = Product(1 + Inflation \%_{Monthly(n)})$ <p>with $n = 1$ to 12</p>
	$ \begin{aligned} n_1 &= 0.16\% \\ n_2 &= 0.34\% \\ n_3 &= 0.51\% \\ n_4 &= 1.59\% \\ n_5 &= 0.09\% \\ n_6 &= 1.51\% \\ n_7 &= 0.90\% \\ n_8 &= 1.57\% \\ n_9 &= -0.03\% \\ n_{10} &= -0.23\% \\ n_{11} &= 1.29\% \\ n_{12} &= 0.24\% \end{aligned} $ $ \begin{aligned} &= Product(1 + Inflation \%_{Monthly(n)}) \\ Inflation_{Yearly} &= 8.21\% \end{aligned} $
Growth in annuity	$Annuity_t = Annuity_{t-1} \times (1 + Inflation_{t-1})$
	$ \begin{aligned} Annuity_t^* &= R2\ 083.33 \times (1 + 0.082) \\ &= R2\ 254.30^{**} \end{aligned} $
	** $Annuity_t$ is controlled to be within the regulatory 2.5% and 17.5% annual drawdown rate.

Table 4.10: Numerical Example (continued)

Discounting Cash Flows	Example
The annuity received in month n was discounted by the geometric average of the monthly inflation (month 1 to n). The same holds for the terminal value, i.e. the remaining value that was left over in the fund at the death of the retiree(s)	$PV_t = \frac{CF_1}{(1 + I_1)} + \frac{CF_2}{(1 + I_1)(1 + I_2)}$ $+ \frac{CF_3}{(1 + I_1)(1 + I_2)(1 + I_3)} + \dots +$ $\frac{CF_{252} + Terminal\ Value_{252}}{(1 + I_1)(1 + I_2) \dots (1 + I_{252})}$ <p style="text-align: center;"><i>with:</i></p> <p style="text-align: center;">$PV_t = \text{Present value of cash flows}$ $CF_1 = \text{Monthly annuity received}$ $I_1 = \text{Monthly inflation}$ $Terminal\ Value_{252} =$ <i>remaining value that was left over in the fund at the death of the retiree(s)</i></p>
	$PV_t = \frac{R2\ 083.33}{(1 + 0.16\%)} + \frac{R2\ 083.33}{(1 + 0.16)(1 + 0.34\%)}$ $+ \frac{R2\ 083.33}{(1 + 0.16\%)(1 + 0.34\%)(1 + 0.51\%)} + \dots +$ $\frac{R10\ 955.88 + R1\ 876\ 289.48}{(1 + 0.16\%)(1 + 0.34\%) \dots (1 - 0.3\%)}$ $= R1\ 582\ 284.12$

Source: Author (2015)

4.4 Life Annuities

Four different life, or guaranteed, annuities were analysed in this study. Present values for these annuities were obtained by following the exact same discounting methodology as illustrated in Table 4.10. All annuity quotes for the retiree scenarios in Table 1.1 were provided by Sanlam and an initial retirement capital of R1 000 000 was assumed. Scenarios 5 to 8 were priced at joint-life rates. It was deemed necessary to include these scenarios in the study as 58% of the South African population between the ages 55 to 64 are still married, and 35.5% of the people in this age group have already retired. Of the population aged 65 years or

older 34.5% are still married and 63% of the people in this age group are retired (Eighty20, 2015).

It should be noted that these joint-life rates were priced at a 75% spouse's pension. This implies that a spouse's pension of 75% of the main member's pension will be payable to the spouse if the main member dies and is survived by the spouse. It was assumed, based on the a(55) life mortality table that in each of the cases tested in this study the main member was survived by the spouse. The annuities were also priced at a guarantee period of five years.

The quotes for all annuity products are presented in Table 4.11. Fees were already accounted for in these quotes.

Table 4.11: Annuity Quotes

Case	Age	Age (Spouse)	Level Annuity	Annuity (5% escalating)	Inflation-linked	TCP
1	55	-	R8 075	R5 076	R4 107	R4 532
2	60	-	R8 527	R5 595	R4 678	R5 122
3	65	-	R9 110	R6 251	R5 404	R5 859
4	70	-	R9 898	R7 123	R6 361	R6 814
5	55	52	R7 389	R4 318	R3 316	R3 700
6	60	57	R7 618	R4 642	R3 683	R4 088
7	65	62	R7 941	R5 057	R4 159	R4 583
8	70	67	R8 416	R5 623	R4 800	R5 237

Source: Author (2015)

4.4.1 Level Annuity

Table 4.12 is presented as an example of the discounting process applied to level annuities. The actual monthly annuity is given in Table 4.11 and is constant throughout the life of the retiree(s). Each of the 1 000 different inflation iterations were used for discounting purposes and 8 000 different present values were thus obtained.

Table 4.12: Numerical Example

Discounting Cash Flows	Example
The annuity received in month n was discounted by the geometric average of the monthly inflation (month 1 to n).	$PV_t = \frac{CF_1}{(1 + I_1)} + \frac{CF_2}{(1 + I_1)(1 + I_2)}$ $+ \frac{CF_3}{(1 + I_1)(1 + I_2)(1 + I_3)} + \dots +$ $\frac{CF_{252}}{(1 + I_1)(1 + I_2) \dots (1 + I_{252})}$ <p style="text-align: center;"><i>with:</i> PV_t = Present value of cash flows CF_1 = Monthly annuity received I_1 = Monthly inflation</p>
	$PV_t = \frac{R8\ 075}{(1 + 0.16\%)} + \frac{R8\ 075}{(1 + 0.16\%)(1 + 0.34\%)}$ $+ \frac{R8\ 075}{(1 + 0.16\%)(1 + 0.34\%)(1 + 0.51\%)} + \dots +$ $\frac{R8\ 075}{(1 + 0.16\%)(1 + 0.34\%) \dots (1 + -0.3\%)}$ $= R1\ 046\ 709.97$

Source: Author (2015)

4.4.2 Escalating Annuity

Table 4.13 is presented as an example of the discounting process applied to escalating annuities. The initial monthly annuity is given in Table 4.11 and increases annually, on a compounding basis, by 5% throughout the life of the retiree(s). For example, the initial annuity for retiree case number 1 was equal to R5 076. This annuity was paid out for the first twelve months after which it increased to $R5\ 076 \times (1.05) = R5\ 329.80$.

Each of the 1 000 different inflation iterations were used for discounting purposes resulting in 8 000 present values.

Table 4.13: Numerical Example

Discounting Cash Flows	Example
The annuity received in month n was discounted by the geometric average of the monthly inflation (month 1 to n).	$PV_t = \frac{CF_1}{(1 + I_1)} + \frac{CF_2}{(1 + I_1)(1 + I_2)}$ $+ \frac{CF_3}{(1 + I_1)(1 + I_2)(1 + I_3)} + \dots +$ $\frac{CF_{252}}{(1 + I_1)(1 + I_2) \dots (1 + I_{252})}$ <p style="text-align: center;"><i>with:</i> PV_t = Present value of cash flows CF_1 = Monthly annuity received I_1 = Monthly inflation</p>
	$PV_t = \frac{R5\ 076}{(1 + 0.16\%)} + \frac{R5\ 076}{(1 + 0.16\%)(1 + 0.34\%)}$ $+ \frac{R5\ 076}{(1 + 0.16\%)(1 + 0.34\%)(1 + 0.51\%)} + \dots +$ $\frac{R13\ 468.14}{(1 + 0.16\%)(1 + 0.34\%) \dots (1 - 0.3\%)}$ $= R979\ 772.33$

Source: Author (2015)

4.4.3 Inflation-linked Annuity

This section describes the calculation and discounting process of the inflation-linked annuity model in this study. Table 4.14 is presented as a numerical example of the calculations followed. The initial monthly annuity is given in Table 4.11 and increases annually, on a compounding basis, by the previous year's inflation throughout the life of the retiree(s). For example, the initial annuity for retiree case number 1 was equal to R4 107. This annuity was paid out for the first twelve months after which it increased to $R4\ 107 \times (1.0821) = R4\ 444.03$.

Each of the 1 000 inflation iterations were used to increase the initial annuity. The cash flow received in month n was discounted by the geometric average of the monthly inflation (month 1 to n).

Table 4.14: Numerical Example

Investment Process at the End of Month 13	Example
The investment process repeats itself at the end of each year.	
The calculation of the thirteenth <i>monthly</i> annuity payable is as follows: First the previous year's (yearly) simulated inflation has to be calculated.	<p>Inflation was treated as an asset class and simulated along with the six other asset classes. Monthly CPI percentages were subsequently simulated.</p> <p>The geometric average of the monthly inflation is calculated so as to provide a yearly inflation percentage.</p>
Inflation	$Inflation_{Yearly} = Product(1 + Inflation \%_{Monthly(n)})$ <p>with $n = 1$ to 12</p>
	$ \begin{aligned} n_1 &= 0.16\% \\ n_2 &= 0.34\% \\ n_3 &= 0.51\% \\ n_4 &= 1.59\% \\ n_5 &= 0.09\% \\ n_6 &= 1.51\% \\ n_7 &= 0.90\% \\ n_8 &= 1.57\% \\ n_9 &= -0.03\% \\ n_{10} &= -0.23\% \\ n_{11} &= 1.29\% \\ n_{12} &= 0.24\% \end{aligned} $ $= Product(1 + Inflation \%_{Monthly(n)})$ $Inflation_{Yearly} = 8.21\%$
Growth in annuity	$Annuity_t = Annuity_{t-1} \times (1 + Inflation_{t-1})$
	$ \begin{aligned} Annuity_t &= R4\ 107 \times (1 + 0.0821) \\ &= R4\ 444.03 \end{aligned} $

Table 4.14: Numerical Example (continued)

Discounting Cash Flows	Example
The annuity received in month n was discounted by the geometric average of the monthly inflation (month 1 to n).	$PV_t = \frac{CF_1}{(1 + I_1)} + \frac{CF_2}{(1 + I_1)(1 + I_2)}$ $+ \frac{CF_3}{(1 + I_1)(1 + I_2)(1 + I_3)} + \dots$ $\frac{CF_{252}}{(1 + I_1)(1 + I_2) \dots (1 + I_{252})}$ <p style="text-align: center;"><i>with:</i> PV_t = Present value of cash flows CF_1 = Monthly annuity received I_1 = Monthly inflation</p>
	$PV_t = \frac{R4\ 107}{(1 + 0.16\%)} + \frac{R4\ 107}{(1 + 0.16\%)(1 + 0.34\%)}$ $+ \frac{R4\ 107}{(1 + 0.16\%)(1 + 0.34\%)(1 + 0.51\%)} + \dots +$ $\frac{R19\ 054.50}{(1 + 0.16\%)(1 + 0.34\%) \dots (1 - 0.3\%)}$ $= R992\ 661.30$

Source: Author (2015)

4.4.4 TCPP Annuity

The Complete Picture Pension annuity, as with all the other annuities, was explained in the second chapter. It is briefly discussed again below.

The TCPP annuity guarantees annuitants an increase in their yearly annuity according to Formula 2.2. This increase is a function of the last five years' returns of a portfolio comprising of 50% of the JSE Top 40 Total Return Index and 50% of the ALBI. The increase is subject to a minimum of 0% (TCPP, 2014).

$$Increase = Max \left\{ \frac{[(1+i_1)(1+i_2)(1+i_3)(1+i_4)(1+i_5)]^{\frac{1}{5}}}{1+PRI} (1 - 0.025) - 1; 0 \right\} \quad (Formula 2.2)$$

with:

$$i_n = (0.5Return_{Top40} + 0.5Return_{ALBI})$$

$$PRI = 3.5\%$$

Table 4.15 is presented as an example of the methodology applied to the TCPP annuity. The initial monthly annuity is given in Table 4.11 and increases annually by the geometric average derived from Formula 2.2. Each of the 1 000 return iterations were used to calculate the present values for the eight different retiree scenarios.

Table 4.15: Numerical Example

Investment Process at the End of Month 13	Example
The investment process repeats itself at the end of each year.	
The calculation of the thirteenth <i>monthly</i> annuity payable is as follows: First the current year's Top40 and ALBI returns are calculated.	Monthly returns were simulated and the geometric average of these 12 monthly returns equals the yearly return for the asset class.
Top40	$Top40 Return \%_{Yearly}$ $= Product(1 + Top40 Return \%_{Monthly(n)})$ <p>with $n = 1$ to 12</p>

Table 4.15: Numerical Example (continued)

Top40 Return	$n_1 = 2.60\%$ $n_2 = 1.54\%$ $n_3 = -3.79\%$ $n_4 = 1.00\%$ $n_5 = -1.81\%$ $n_6 = 0.7\%$ $n_7 = 6.07\%$ $n_8 = 3.39\%$ $n_9 = -2.57\%$ $n_{10} = -2.44\%$ $n_{11} = -2.62\%$ $n_{12} = 1.95\%$ $= \text{Product}(1 + \text{Top40 Return } \%_{\text{Monthly}(n)})$ $\text{Top40 Return}\%_{\text{Yearly}} = 3.59\%$
ALBI	$\text{ALBI Return}\%_{\text{Yearly}}$ $= \text{Product}(1 + \text{ALBI Return } \%_{\text{Monthly}(n)})$ <i>with $n = 1$ to 12</i>
ALBI Return	$n_1 = 4.06\%$ $n_2 = 1.88\%$ $n_3 = -0.30\%$ $n_4 = -1.91\%$ $n_5 = 9.81\%$ $n_6 = 1.48\%$ $n_7 = 2.33\%$ $n_8 = 0.52\%$ $n_9 = 1.31\%$ $n_{10} = 1.60\%$ $n_{11} = 2.97\%$ $n_{12} = 2.67\%$ $= \text{Product}(1 + \text{ALBI Return } \%_{\text{Monthly}(n)})$ $\text{ALBI Return}\%_{\text{Yearly}} = 29.33\%$

Table 4.15: Numerical Example (continued)

Growth in annuity	Example
Formula 4.2 is used to calculate the annual increase in annuity.	$\text{Max} \left\{ \frac{[(1+i_1)(1+i_2)(1+i_3)(1+i_4)(1+i_5)]^{\frac{1}{5}}}{1+PRI} (1-0.025) - 1; 0 \right\}$
Calculating i_n (before fees)	$i_{n(gross)} = (0.5\text{Return}_{Top40} + 0.5\text{Return}_{ALBI})$ $= (0.5 \times 3.59\% + 0.5 \times 29.33\%)$ $= 16.46\%$
Calculating i_n (after fees)	$i_{n(net)} = [(1 + i_{n(gross)}) \times (1 - 0.025)] - 1$ $= [(1 + 16.46\%) \times (1 - 0.025)] - 1$ $= 13.55\%$
Calculating the increase	<p>Prior (gross) returns equal 11% which translate into 8.23% net of fees. This figure is used for the previous four years' returns, and 13.55% is used for the fifth return.</p> $\frac{[(1 + 8.23\%)(1 + 8.23\%)(1 + 8.23\%)(1 + 8.23\%)(1 + 13.55\%)]^{\frac{1}{5}}}{1 + 0.035} - 1$ $\text{Max} \{5.57\%; 0\%\} = 5.57\%$
Growth in annuity	$\text{Annuity}_t = \text{Annuity}_{t-1} \times (1 + \text{Increase}_t)$
	$\text{Annuity}_t = \text{R4 } 532 \times (1 + 0.0557)$ $= \text{R4 } 784.62$

Table 4.15: Numerical Example (continued)

Discounting Cash Flows	Example
The annuity received in month n was discounted by the geometric average of the monthly inflation (month 1 to n).	$PV_t = \frac{CF_1}{(1 + I_1)} + \frac{CF_2}{(1 + I_1)(1 + I_2)}$ $+ \frac{CF_3}{(1 + I_1)(1 + I_2)(1 + I_3)} + \dots$ $\frac{CF_{252}}{(1 + I_1)(1 + I_2) \dots (1 + I_{252})}$ <p>with:</p> <p>PV_t = Present value of cash flows CF_1 = Monthly annuity received I_1 = Monthly inflation</p>
	$PV_t = \frac{R4\ 532}{(1 + 0.16\%)} + \frac{R4\ 532}{(1 + 0.16\%)(1 + 0.34\%)}$ $+ \frac{R4\ 532}{(1 + 0.16\%)(1 + 0.34\%)(1 + 0.51\%)} + \dots +$ $\frac{R21\ 273.49}{(1 + 0.16\%)(1 + 0.34\%) \dots (1 - 0.3\%)}$ $= R1\ 077\ 430.34$

Source: Author (2015)

4.5 Ruin Calculations

This study also included ruin probability measurements. Several definitions, or benchmarks, were used as the measurement of ruin. This section describes how these calculations were conducted in determining the probabilities of ruin.

Ruin calculations were mainly conducted for living annuities. Section 4.5.1 discusses the ruin approach in terms of a financial ruin model and Section 4.5.2 discusses ruin in terms of whether or not the underlying living annuity portfolio could sustain the annuities paid by the guaranteed products.

4.5.1 Living Annuity Inflation Model

A model was constructed that tested whether or not the living annuity analysed in this study could provide protection against inflation. Ruin was defined as the simulated annuities not being able to increase with the previous year's inflation. In other words, if the drawdown cap of 17.5% was reached in any of the years wherein a retiree was still eligible to receive an annuity, the payment was recorded as a failure, or said to be in ruin. Rather than declaring that specific strategy a complete failure, the model was designed to keep simulating payments and to record the total payment failures during the life of the retiree.

Table 4.16 is presented as a numerical example of this ruin definition.

Table 4.16: Numerical Example

Background	Example
For each of the retirees in cases 1 to 8 in Table 4.1 a retirement date of 1 January 2015 and R1 000 000 in retirement capital is assumed.	
Retiree Case	1
Date of death: The annuity will continue to make payments for the number of years specified in Table 4.1.	21 years from now
Asset Allocation: Each of the four in Table 4.8.	Aggressive (AA1)
Initial drawdown rate: Each of the three drawdown rates stipulated.	5%
Drawdown strategy	Increases by the previous year's inflation
Drawdown Rate and Ruin	Example
Each year the annual drawdown rate is controlled via the annuity paid to be within regulatory limits.	$\frac{[Annuity_t \times (1 + Inflation_t)] \times 12}{Fund\ Value\ @\ Year\ End_t}$ $\geq 2.5\% \text{ and } \leq 17.5\%$
Annuity received in 2028	R11 662.22
Simulated inflation for 2028	8.58%
Drawdown limits tested	$\frac{[R11\ 662.22 \times (1 + 8.58\%)] \times 12}{R701\ 105.39} = 21.67\%$

Table 4.16: Numerical Example (continued)

Annuity to be paid in 2029	$Annuity_t = 17.5\% \times \frac{Fund\ Value\ @\ Year\ End_t}{12}$
	$Annuity_t = 17.5\% \times \frac{R701\ 105.39}{12}$ $= R10\ 224.45$
The amount of times the upper cap was breached is recorded and added together.	$Ruin\ \# = \sum \# \text{ times upper cap is breached}$

Source: Author (2015)

The example above depicts a specific year's annuity payable that is classified as a failure. All failures for this specific iteration are then added up. This totalled six for this specific retiree scenario. The process is repeated for each of the 1 000 return iterations. Results and conclusions from these calculations are presented in the next chapter.

4.5.2 Annuity Replacement Models

Models were also constructed that replaced the annuities generated by the living annuity with each of the annuities generated by the guaranteed annuities. This tested whether or not the living annuity portfolio would be able to sustain payments that were made by guaranteed annuities. This section presents the methodology behind the analysis. Only the guaranteed level annuity is presented here as the process is homogeneous across all guaranteed annuities.

4.5.2.1 Guaranteed Level

The cash flows generated by the living annuity were replaced by the cash flows from the guaranteed annuities for each of the eight retiree cases. The living annuity calculations thus followed the exact same approach as in Table 4.10 but the calculation of the annuity itself and the different initial drawdown rates of the annuity were ignored.

Table 4.17 is presented as an example of this annuity replacement process.

Table 4.17: Numerical Example

Background	Example
For each of the retirees in cases 1 to 8 in Table 4.1 a retirement date of 1 January 2015 and R1 000 000 in retirement capital is assumed.	
Retiree Case	1
Date of death: The annuity will continue to make payments for the number of years specified in Table 4.1.	21 years from now
Asset Allocation: Each of the four in Table 4.8.	Aggressive (AA1)
Initial drawdown rate	n/a
Drawdown strategy	Each monthly guaranteed annuity substitutes the original annuity generated by the living annuity. The annuity is controlled to be within the regulatory limits.
	Initial annuity: R2 083.33 (if a 2.5% drawdown rate is applied) Substitute initial annuity: R8 075 (as per Table 4.12)
Increases in annuities	The increases are in line with what was simulated in each annuity's case. For example, the 5% escalating annuity still increases annually with 5%.
The amount of times the upper cap was breached is recorded and added together.	$Ruin\ \# = \sum \# \text{ times upper cap is breached}$

Source: Author (2015)

Ruin calculations were conducted in exactly the same fashion as per Table 4.16. The number of payment failures, characterised by the upper cap being breached, were recorded and used in the analysis in the next chapter. The process was repeated for four asset allocations, eight retiree scenarios and with each of the 1 000 return iterations yielding 32 000 different results per guaranteed annuity.

Chapter 5

Results

This chapter discusses the results obtained in the study. The chapter is divided into eight different sections. Each of the eight sections individually addresses the eight retiree cases analysed. The same analysis process is used for each of the retiree scenarios. The first section, however, contains a more detailed explanation of the steps followed to arrive at the conclusions.

5.1 Retiree Case 1

This section presents the results for a 55 year-old male retiree with a life expectancy of 21 years.

5.1.1 Present Values Analysis

A total of 1 000 present values were generated for each of the four guaranteed annuities as was explained in Chapter 4. The living annuity, however, followed 12 different strategies and subsequently had 12 000 present values. The following examples are given to indicate how they are differentiated from each other in this study:

- R1-1-1 refers to retiree case 1 (as per Table 1.1); initial drawdown of 2.5%; aggressive asset allocation 1 (as per Table 4.7)
- R2-2-3 refers to retiree case 2 (as per Table 1.1); initial drawdown of 5%; moderate asset allocation 3 (as per Table 4.7)
- R3-3-4 refers to retiree case 3 (as per Table 1.1); initial drawdown of 7.5%; conservative asset allocation 4 (as per Table 4.7)

The first step in the present value analysis was to arrange each of the 1 000 present values obtained, for each of the five annuities analysed, from lowest to highest.

Figure 5.1 depicts the present values obtained for the 55 year-old retiree. The average present values for the *guaranteed* annuities, except for the TCPP annuity, are represented by the solid straight lines in the figure. This makes for better visualisation of the results and creates a benchmark against which the living annuity strategies can be measured. Living annuity strategies can be differentiated as follows: asset allocations are coloured red, black, blue, and green for aggressive to conservative portfolios, respectively. Strategies that followed a 2.5% initial drawdown rate are represented by the solid lines and the dashed lines represent the 5% initial drawdown rate strategies. Finally, the 7.5% initial drawdown rate strategies are represented by the dotted lines. The increase in the drawdown percentage in subsequent years was equal to the previous year's inflation rate.

What is clear from the figure is the up- and downside potential offered by the living annuities. While the majority of living annuity present values lie above the initial R1 000 000 capital investment, there are strategies that fail to return this initial investment. This is in contrast with the guaranteed annuities which, on average, did not deviate too far from R1 000 000 in present value terms.

Furthermore, it is also noteworthy to mention the up- and downside potential offered by the TCPP annuity. On the right hand side of Figure 5.1 one can clearly see that present values of this product are significantly lower than that of the living annuity strategies. This makes intuitive sense as the TCPP annuity is also a guaranteed product and therefore should not show greater rewards than the more risky, unguaranteed, living annuity.

What is also evident from the figure is that higher present values, from a living annuity perspective, require lower initial drawdown rates. On the other end of the figure the opposite is true. This is due to the fact that if one knows the underlying fund will suffer major losses during the investment period and will in all likelihood be depleted at the time of death, the maximum possible income might as well be drawn from it. The result is that there is very little capital remaining in the underlying investment portfolio at the retiree's death, after the maximum income had been drawn from the fund. Furthermore, if the lower initial drawdown rate is followed the underlying portfolio increases in size as the withdrawal rate is not greater than the net investment income earned. Thus, based on the power of compounding interest the underlying fund value will show significant growth as time passes. It is important to note that in this case a significant portion of the present value consists of the remaining fund value at the retiree's death as opposed to the actual income earned by him during his lifetime.

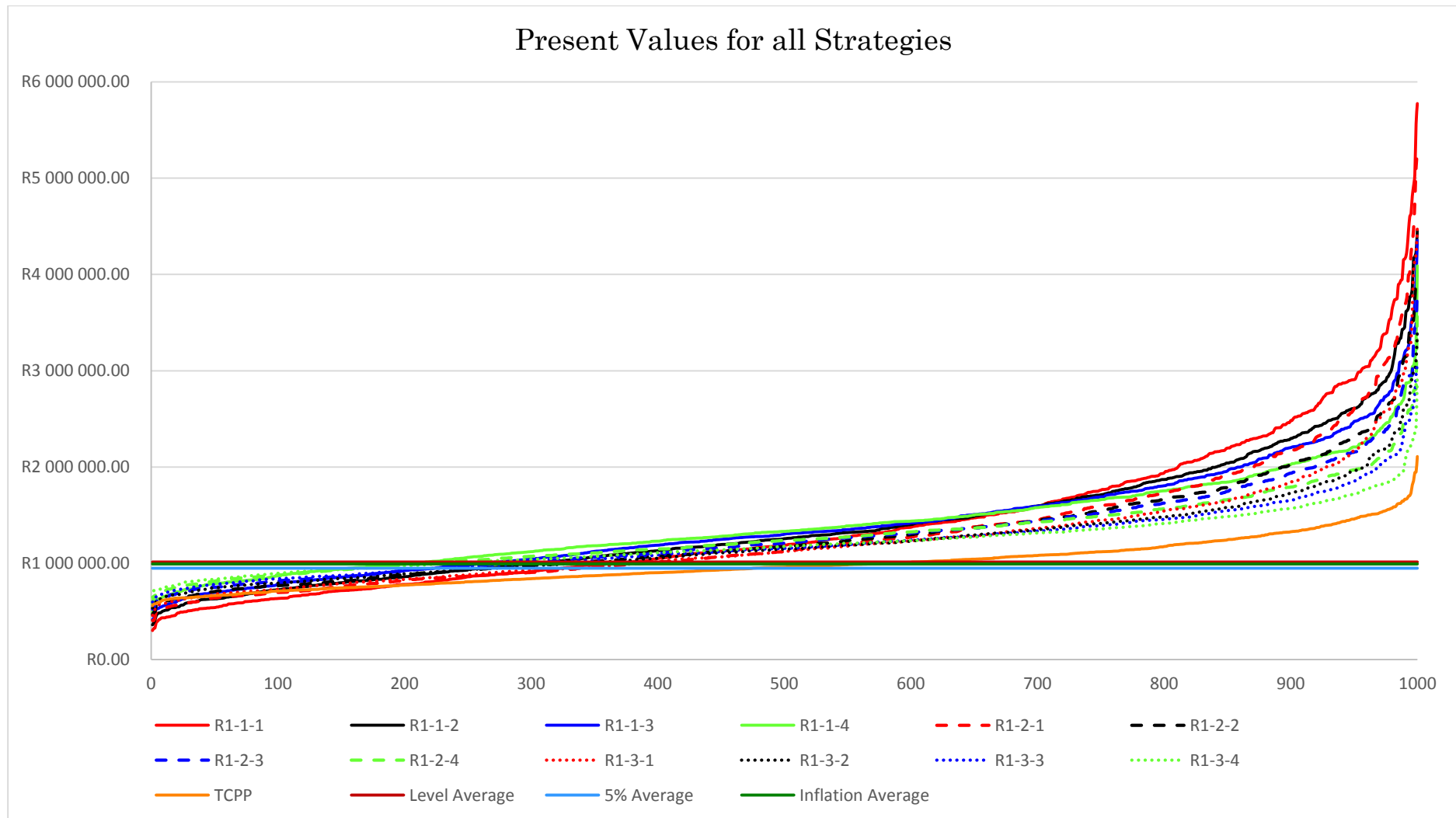


Figure 5.1: Present Values for all Strategies

Source: Author (2015)

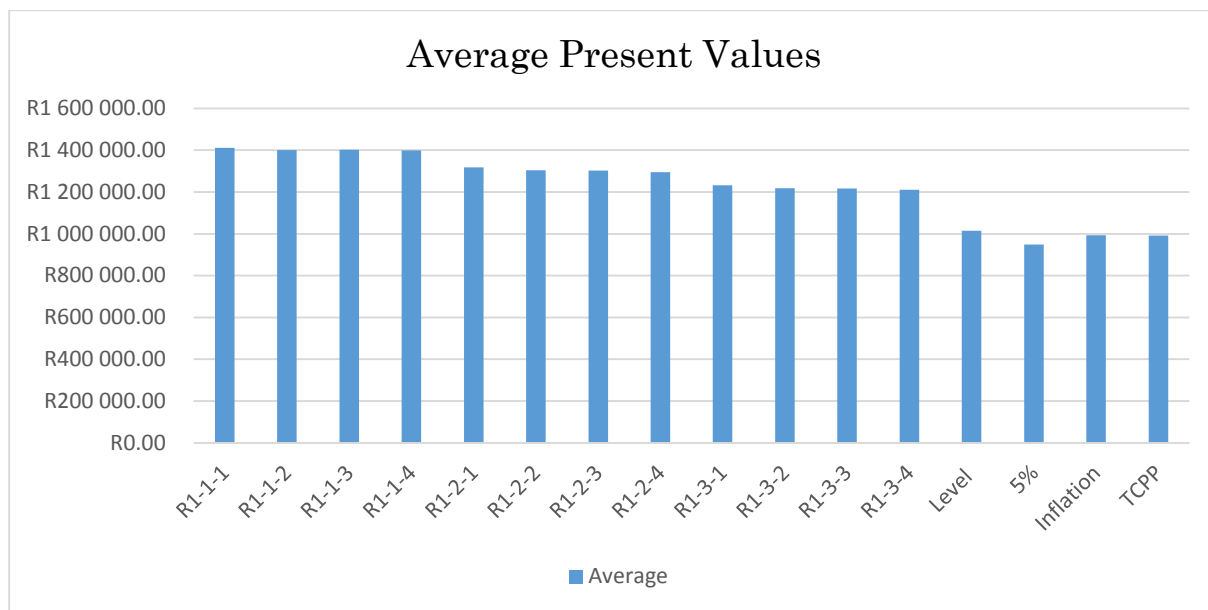


Figure 5.2: Average Present Values

Source: Author (2015)

Figure 5.2 depicts the average present values of the annuities analysed. The more aggressive asset allocations reflect a higher average present value than the conservative portfolios. What is clear from the figure is that all the living annuity strategies, on average, outperformed the guaranteed annuities. Furthermore, the guaranteed annuities all performed equally in relative terms to one another with the level annuity returning the highest present value and the 5% escalating annuity the lowest.

One can also argue that the life expectancy assumed here is only an average figure and that there are retirees who outlive this average figure. This is indeed true and the life expectancy was therefore increased by six years in order to see what effect it would have on present values. Figure 5.3 depicts these results.

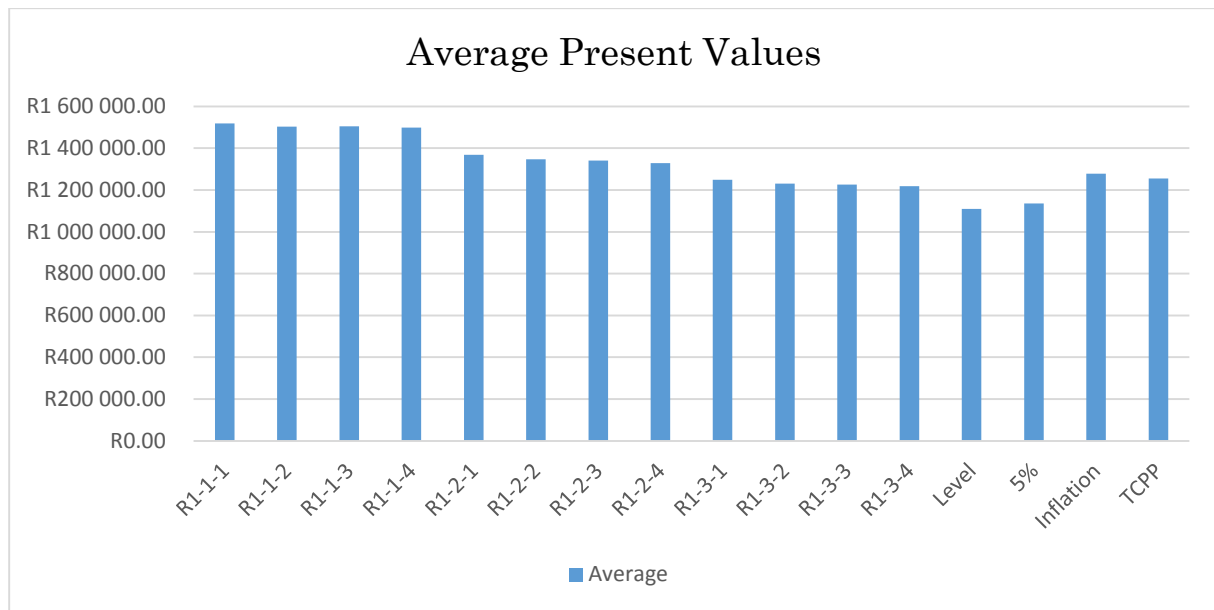


Figure 5.3: Average Present Values (increased life expectancy)

Source: Author (2015)

From this figure the longevity benefit is clearly visible. Not only does the inflation-linked and TCPP present values surpass the R1-3-1 to R1-3-4 strategies, but the 5% escalating annuity is now also favoured as opposed to the level annuity. This result is in accordance with what Goemans and Ncube (2008:42) concluded.

The above figures and results warrant an in depth analysis of these annuities as one cannot simply select the highest present value strategy as the best performing strategy.

5.1.2 Percentile Analysis

The present values obtained were all structured in percentiles in order to better visualise the data. Percentiles represent a specific point in a dataset and indicate a value below which a given percentage of observations in the dataset falls. For example, 20% of the observations in a dataset lie below the 20th percentile.

In this analysis the 20th, 40th, 60th and 80th percentiles were calculated and the number of times the present value of a specific annuity fell between the percentiles were counted. For example, the R1-1-1 living annuity strategy had 300 observations below the 20th percentile, 67

observations between the 20th and 40th percentile, 132 observations between the 40th and 60th percentile, etcetera. Each of these numbers was then divided by 1 000 to present the results as a percentage. Figure 5.4 depicts the results. It is noteworthy to mention that the R1 000 000 mark is around the 40th percentile.

Ideally, what a retiree would want is to invest in a strategy that has the lowest number of observations below the 20th percentile, and the highest number of observations between the 80th and 100th percentile. Analysing Figure 5.4 leads to the conclusion that, from a living annuity perspective, the R1-1-4 living annuity strategy provides a 55 year-old male retiree with the optimal present value outcome.

The level annuity seems the better option when compared to the 5% escalating annuity as this is leaning more to the right of the figure, i.e. 64% of its present values were located in the 40th to 60th percentile range compared to the TCPP annuity's 22% and the 5% escalating annuity's 12%. The inflation-linked annuity provides the most stability in terms of fluctuations around the R1 000 000 initial starting capital, thus making it the safest investment. It is interesting to note that the TCPP annuity outperforms the living annuities around the 40th and 60th percentiles which indicates that retirees might well want to consider such an annuity if they feel that living annuities are too risky, but that they wish to assume a certain level of market risk.

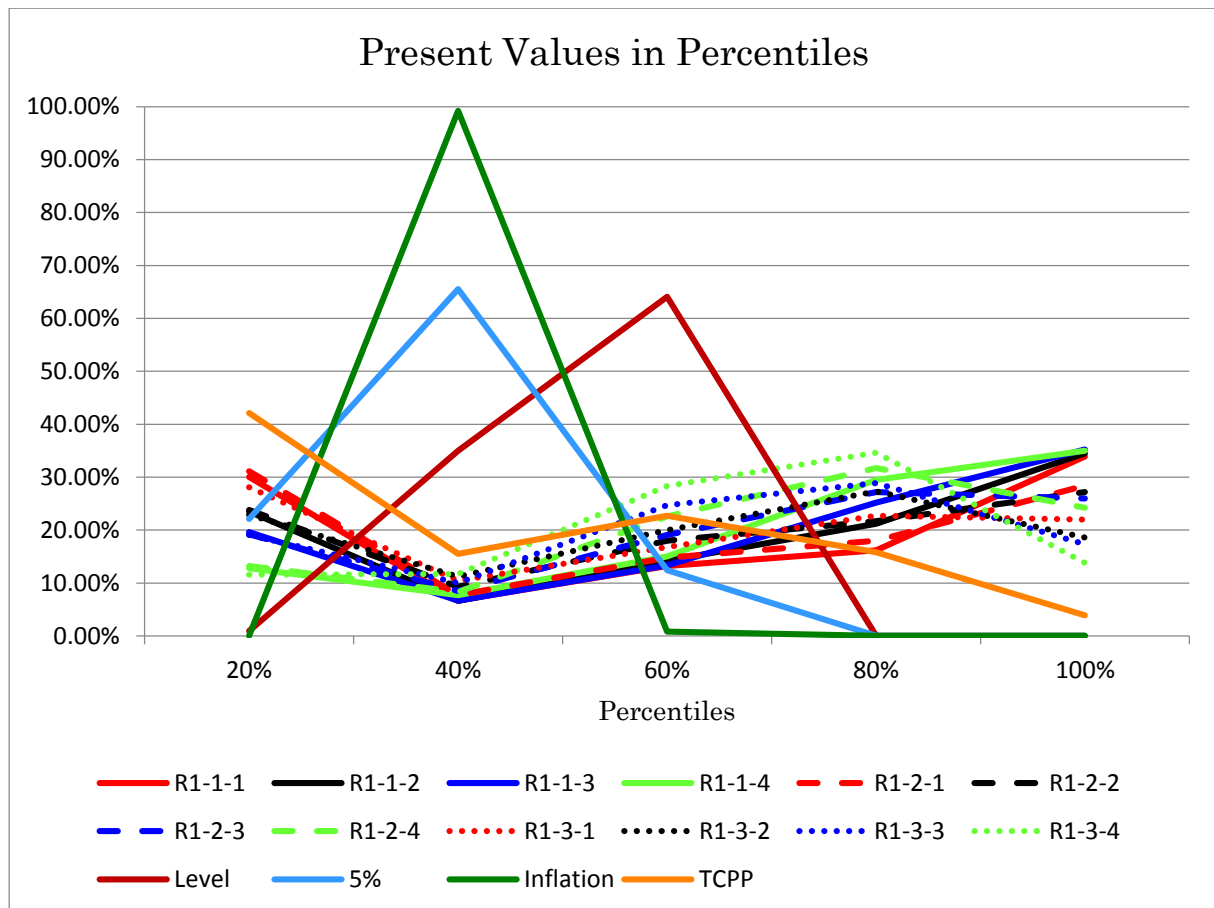


Figure 5.4: Present Values in Percentiles

Source: Author (2015)

While this approach does highlight the relative safety that guaranteed annuities provide, it fails to take into account the risk associated with living annuities. It cannot be concluded that the R1-1-4 living annuity strategy is optimal if the underlying income from this strategy either results in financial ruin or fails to match the income from any of the other strategies. Therefore, one has to further analyse these aspects in order to make a holistic conclusion regarding the strategies.

5.1.3 Financial Ruin Analysis

Financial ruin was defined as the underlying living annuity portfolio reaching the yearly 17.5% drawdown cap that is imposed on these annuities. If the annuity drawn from the underlying portfolio reached the 17.5% drawdown cap the specific iteration was recorded as a

failure. This process was repeated for each of the 1 000 return iterations and for each living annuity strategy.

Figure 5.5 depicts the ruin probabilities of each living annuity strategy and structures the results in five intervals over the span of the retiree's life.

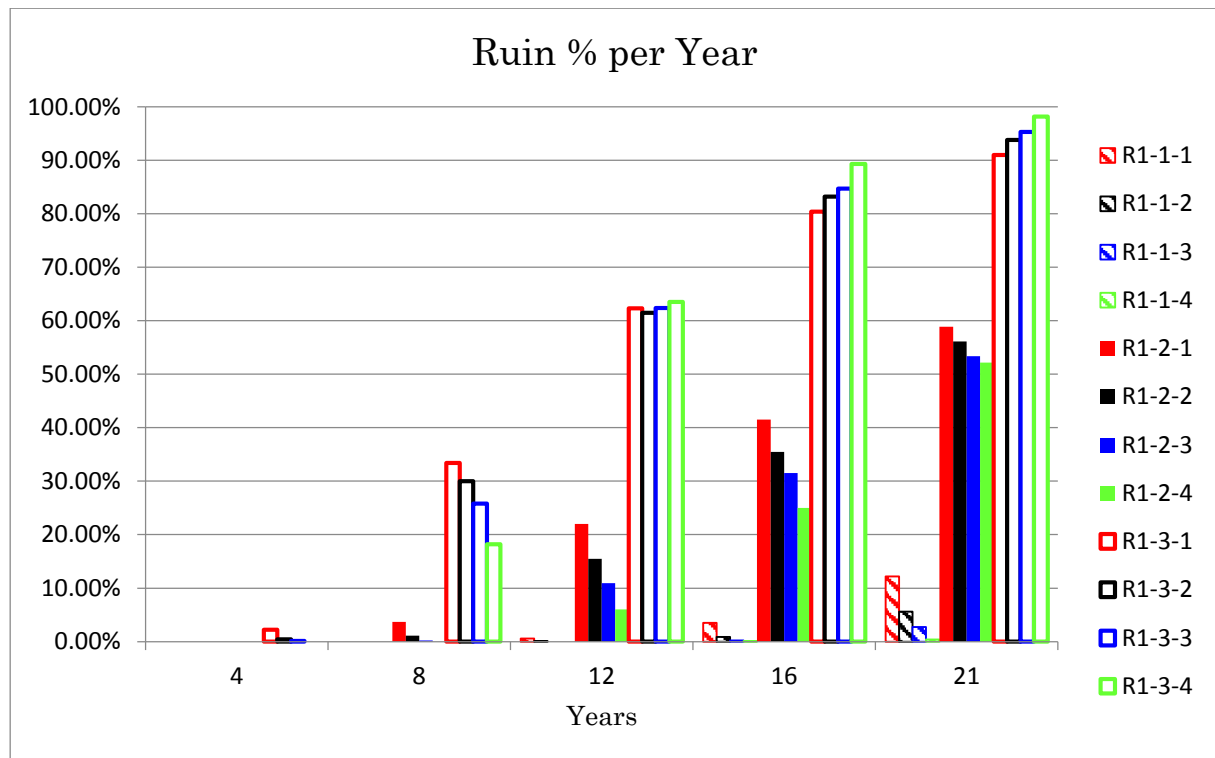


Figure 5.5: Ruin % per Year

Source: Author (2015)

From this figure it is clear that the higher initial drawdown rate of 7.5% is unsustainable and even the 5% strategy has relatively high ruin probabilities. At the end of year 12 the 7.5% strategies have ruin probabilities of around 60%, regardless of asset allocation. At the end of years 16 and 21 the conservative asset allocations resulted in higher ruin probabilities in the case of an initial 7.5% drawdown rate. This confirms prior results that higher present values demand a more aggressive asset allocation.

Furthermore, similar to the conclusion of Goemans and Ncube (2008:34), it was established that aggressive asset allocations have higher ruin probabilities than the conservative allocations for the 2.5% and 5% initial drawdown rates. For higher initial drawdown rates the riskier portfolios have lower ruin probabilities than conservative portfolios in later years. This

is due to the fact that aggressive asset allocations will be able to support higher drawdowns in a high return environment. Nevertheless, the minimum ruin probability is still equal to 91% at the end of year 21 in the case of an initial 7.5% drawdown rate.

The result from this analysis is that a 55 year-old living annuitant with no spouse, and who wants to maintain an inflation-adjusted income, should draw an initial income lower than 5% and invest in more conservative portfolios. This result is also similar to what Beinash (2007:23) found.

5.1.4 Annuity-to-Terminal Value Analysis

Another important factor to take into account when analysing living annuities is the bequest motive, i.e. the desire for the living annuitant to leave a financial inheritance. This is one of the main reasons why these annuities are popular amongst retirees.

The present values from the living annuity strategies were split into two categories: the total annuities paid out during the life of the retiree and the terminal value remaining in the fund at the death of the retiree. These two amounts were then calculated as a percentage of the total present value. This was done for each of the 1 000 return scenarios as well as for each of the 12 living annuity strategies. The average of the annuity and terminal value portion for each respective strategy was then calculated and the results are presented in Figure 5.6.

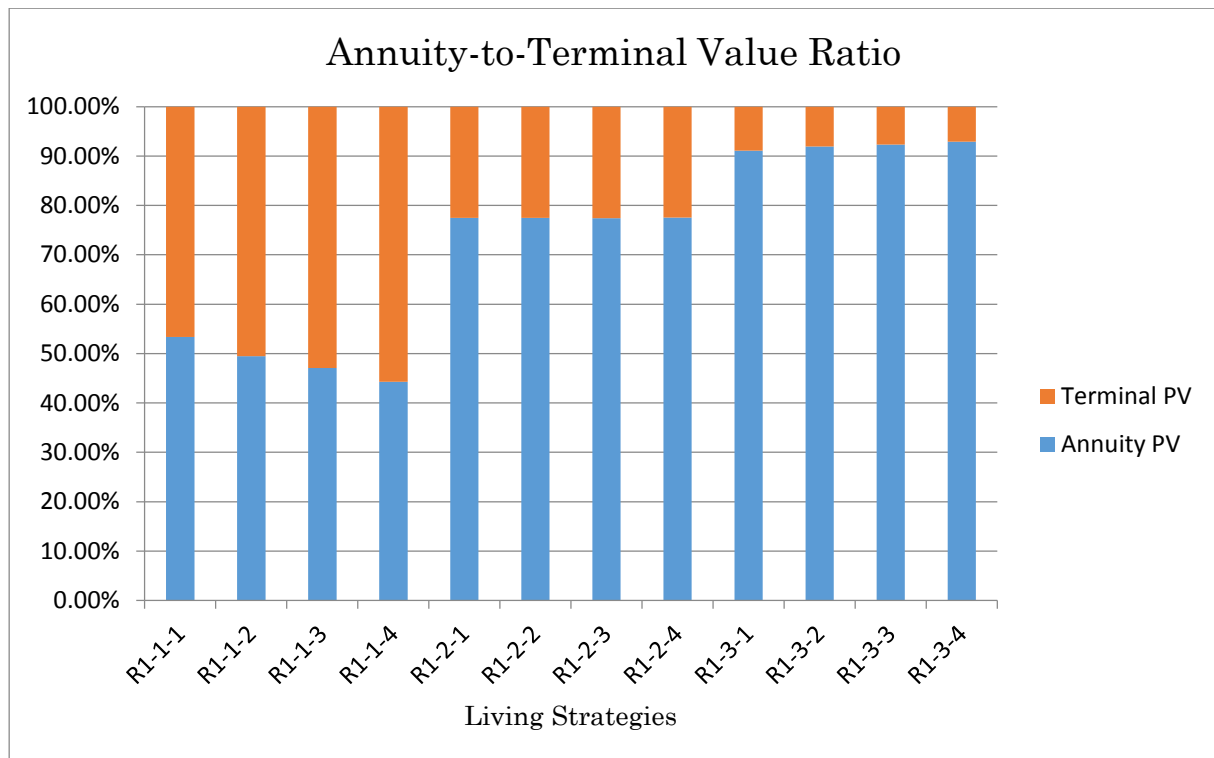


Figure 5.6: Annuity-to-Terminal Value Ratio

Source: Author (2015)

The figure highlights the ruin probability of the higher initial drawdown strategies. Less than 10% in respect of the total present values earned by the 7.5% initial drawdown strategies consist of the terminal value. The majority (around 90%) of the present value is thus generated by the annuity income only. The 5% strategies did not fare much better as approximately 78% of the present values consists of annuity income. The 2.5% strategy, however, depicts a stable and equal relationship between the two variables. Between 44% and 53% consists of annuity income, suggesting that there would be a significant amount of money left in the fund to be inherited by the retiree's heirs.

The figure also exhibits the relative performance of the asset allocations. The sustainable initial drawdown option of 2.5% favours a conservative asset allocation if the bequest motive is taken into account. This corresponds to the results from the ruin analysis and, as is analysed next, the probability of outperforming guaranteed annuities.

5.1.5 Probability of Outperforming Guaranteed Annuities

Seeing that living annuities have higher present values, and in some cases do not result in financial ruin, the probability of achieving a higher present value than the guaranteed annuities was analysed.

All the present values from all the strategies were once again ranked from highest to lowest. The number of times a specific living annuity outperformed the average present values obtained for the four guaranteed annuities were then counted and divided by 1 000 in order to convert them to percentages. Figure 5.7 depicts the results.

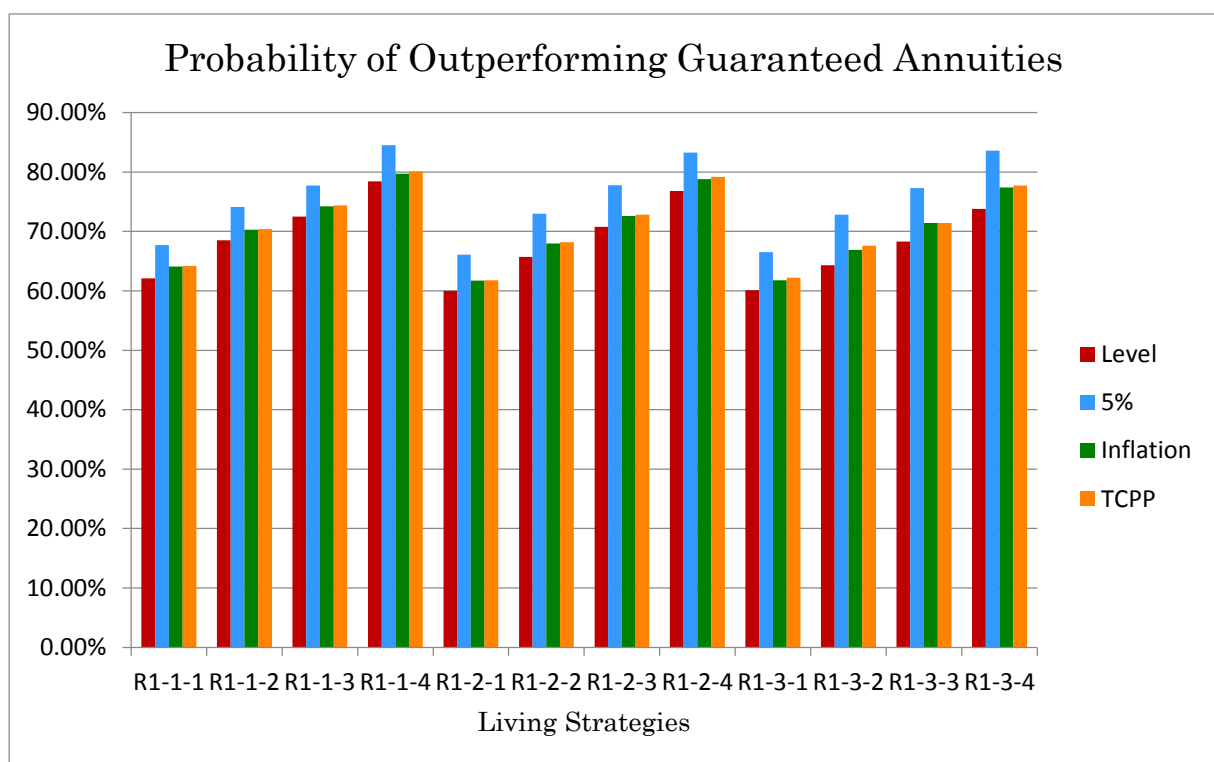


Figure 5.7: Probability of Outperforming Guaranteed Annuities

Source: Author (2015)

From this figure it is clear that living annuities, regardless of the strategy followed, have at least a 60% chance of outperforming guaranteed annuities based on average values. Living annuities had the greatest probability of outperforming 5% escalating annuities and the lowest probability of outperforming level annuities. Furthermore, it appears that conservative asset

allocation strategies had more present values than aggressive strategies that were higher than the guaranteed averages.

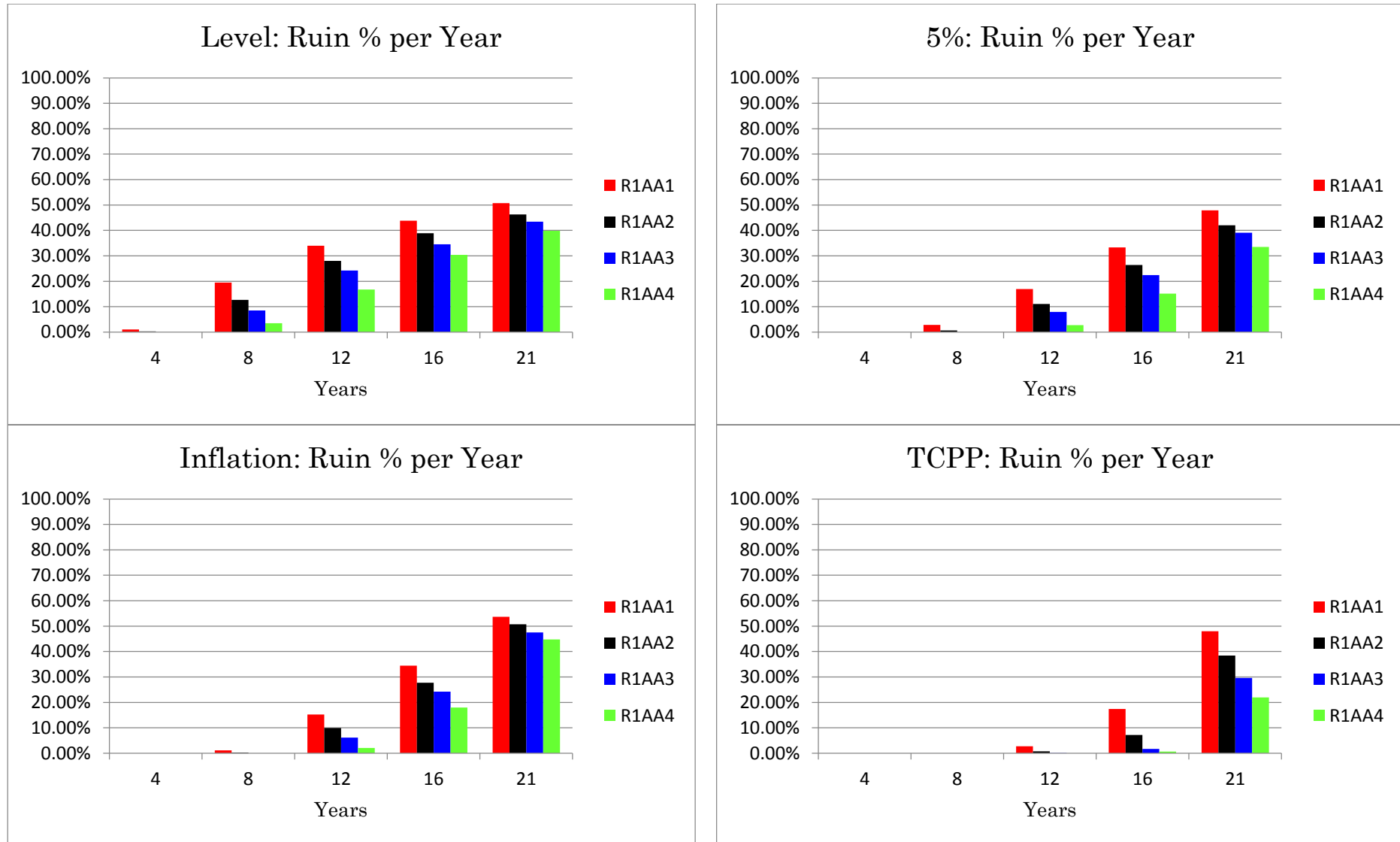
However, this figure has to be viewed together with the financial ruin Figure 5.5. The figure depicts that the 7.5% initial drawdown strategies have a minimum ruin probability of 91% which have a significant negative impact on the outperformance results from Figure 5.7 for these strategies.

5.1.6 Annuity Replacement Model

A second ruin analysis approach was also followed in this study. Section 4.6.2 in Chapter 4 discussed the methodology behind this analysis. In summary, what the Annuity Replacement Model (ARM) analysis does is to determine whether or not the underlying living annuity portfolio, given the different asset allocations, could sustain the actual annuities paid out by each of the four guaranteed annuities analysed. The ruin percentages for each of the guaranteed annuities, and for five time intervals, are presented in Figure 5.8. The figure indicates the results under different asset allocations (AA1 to AA4) for each of the four guaranteed products. R1 refers to retiree case 1.

Higher ruin probabilities, in this case, would be to the benefit of guaranteed annuities as their income comes risk-free and to obtain the same level of income from a living annuity would then come at greater risk.

The results suggest that a male living annuitant, age 55, would at best have to assume a 22% chance of final year financial ruin should he wish to earn the same level of income as a guaranteed annuity. This ruin probability was obtained for a conservative asset allocation that matches the TCPP income. The maximum final year ruin probability obtained was 54% for an aggressive asset allocation that matches an inflation-linked income. This evidence thus favours guaranteed annuities. It is also interesting to note that the level annuity, due to its high initial annuity, results in a ruin percentage range of 4% to 20%, depending on the asset allocation, as soon as the 8th year.

**Figure 5.8: Ruin % per Year**

Source: Author (2015)

5.1.7 Income Stream Comparison

One also has to compare the income streams offered by all the annuities in order to make a holistic comparison of the annuities available to retirees.

Figure 5.9 depicts the average monthly income streams obtained for each annuity. When analysing the average income streams it is clear that the inflation-linked and TCPP annuities start outperforming the other annuity strategies in year 15. They share a similar income stream with the 5% escalating annuity and each of the 5% initial drawdown living annuity strategies up until year 10. The level annuity does indeed provide the highest initial income but at the end of the retiree's expected lifetime it provides one of the lowest incomes.

An analysis of living annuity strategies, based on average values, leads to the conclusion that the 5% initial drawdown strategy with a conservative asset allocation will provide the highest living annuity income in retirement. However, for the first 14 years the 7.5% strategies outperform the 5% strategies by a significant margin, but this is not a sustainable option.

This leads to the conclusion that the 5% initial drawdown living annuity strategies are the superior (living) annuity strategies. This comes, however, with a final year ruin probability of around 50% which it could be argued is too high. It is interesting to see that the 2.5% initial drawdown strategies provide a similar ending annuity and at a much lower final year ruin probability. The annuitant would need to be able to sustain himself on a much lower income though, which makes the guaranteed annuities more attractive.

A mortality shock was also introduced to the model by means of increasing the life expectancy by six years. The result is presented in Figure 5.10. One can conclude that the 2.5% initial drawdown strategies will eventually provide the same level of income as the 5% escalating annuity at the end of year 27. This is still well below the inflation and TCPP income levels. It is also clear that the 5% initial drawdown strategies seem to tail off after year 22. The 2.5% initial drawdown strategies surpass the 5% strategies in year 22, suggesting they are more sustainable in the long run.

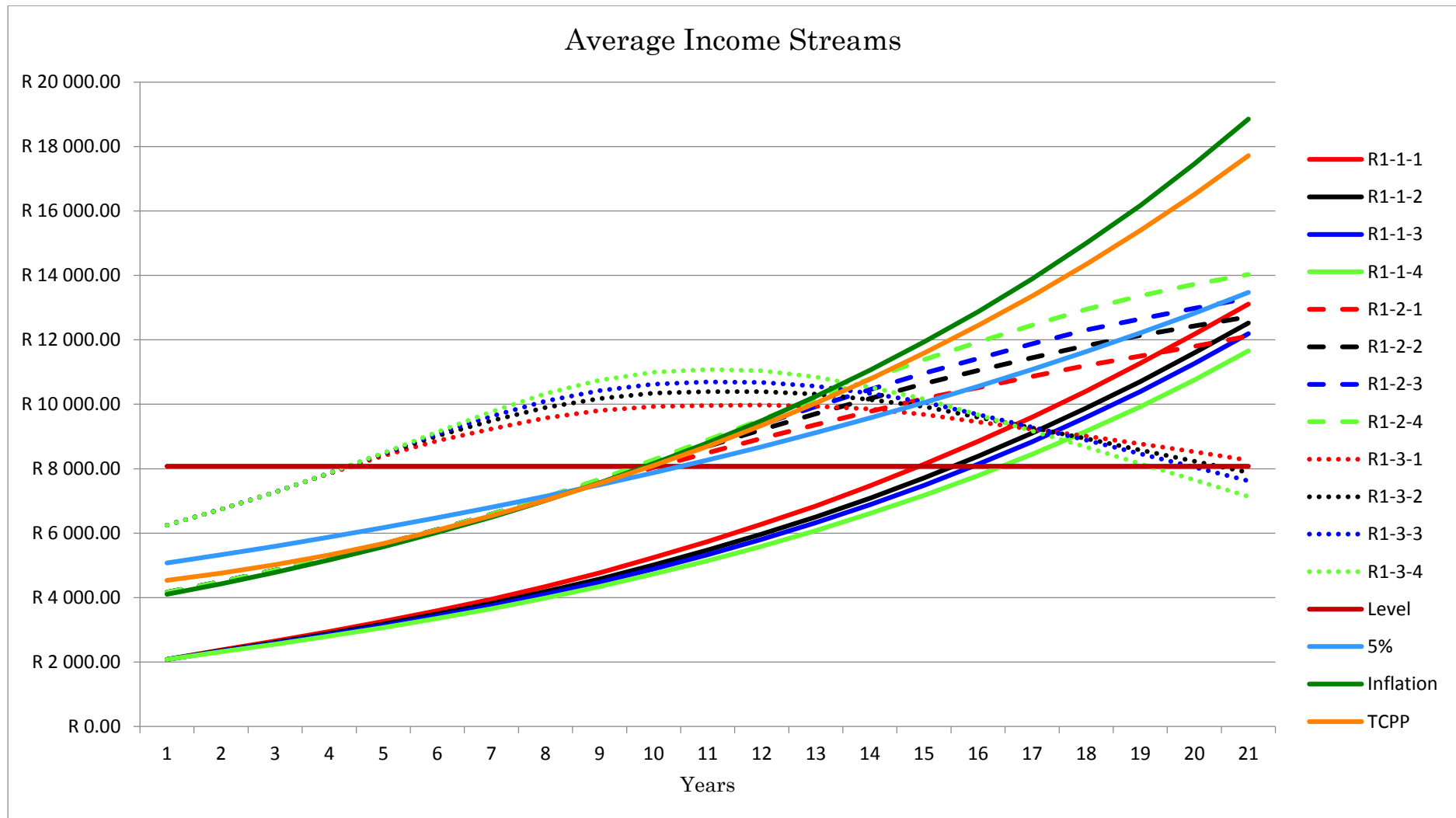


Figure 5.9: Average Income Streams

Source: Author (2015)

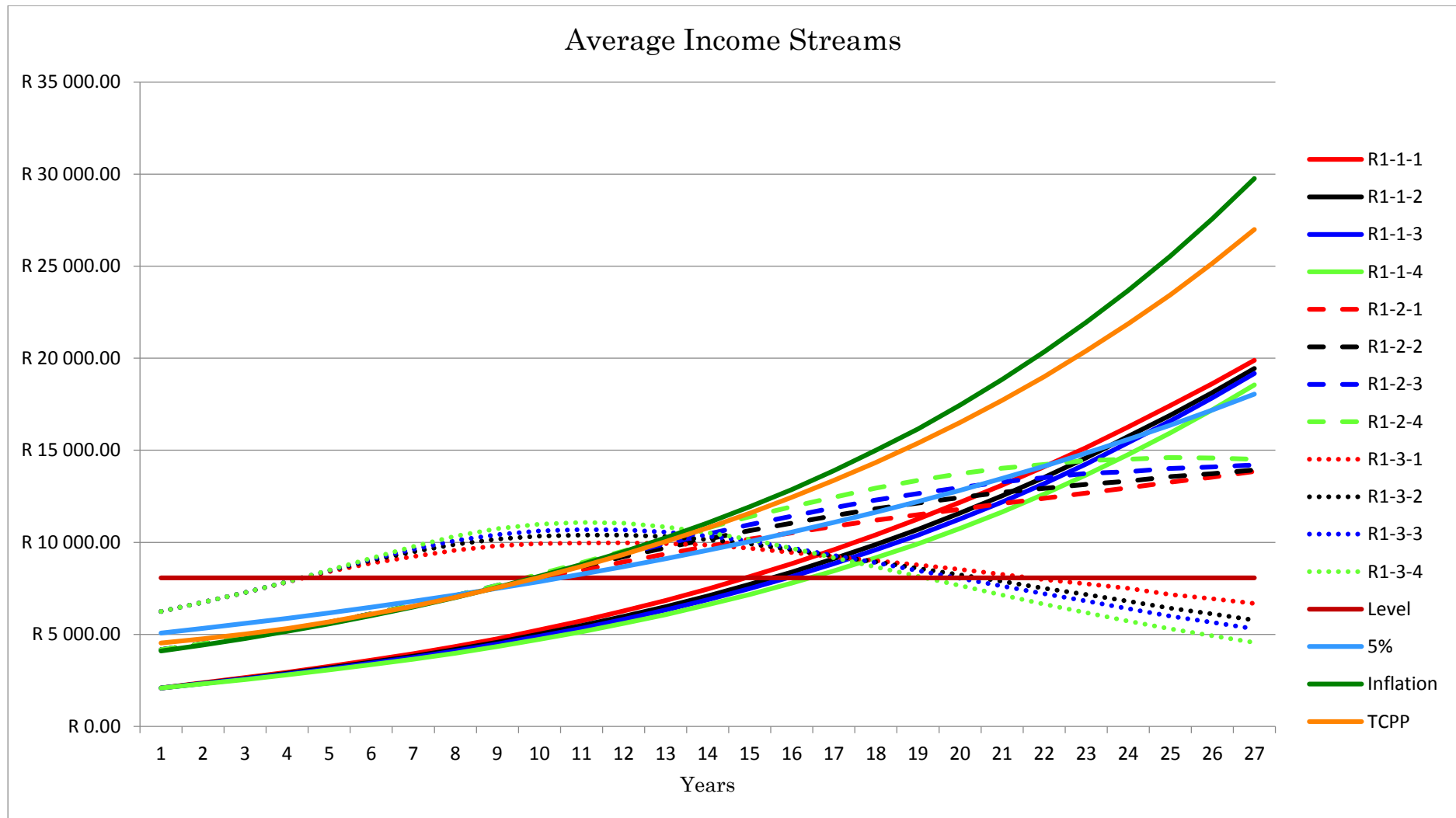


Figure 5.10: Average Income Streams (increased life expectancy)

Source: Author (2015)

5.1.8 Conclusion

Based on the preceding results one can draw certain conclusions for a 55 year-old retiree with a life expectancy of 21 years and no spouse. Pure present value analysis will always favour living annuities with an aggressive asset allocation. However, when the concept of ruin is introduced, as Goemans and Ncube (2008) have also shown, these strategies prove not to be sustainable.

Based on the results one would have to deem a probability of final year financial ruin of around 50% as appropriate if you want to match the income stream from a 5% escalating annuity, with the inflation and TCPP annuity outperforming the 5% annuity in terms of income stream generation. This would then provide the retiree with approximately 22% of total present value in terminal value form for bequest purposes, with the remainder consisting of actual annuity income during the lifetime of the annuitant.

It was found that the R1-1-1 to R1-1-4 living annuity strategies were the safest strategies or the ones that would provide an increasing income at an acceptable ruin probability. Still, the income was significantly lower than any of the other annuities. The retiree might thus be satisfied with this investment should he have another source of income and should he have a significant bequest motive.

Should these living annuity strategies, based on the information above, not fulfil the needs of the retiree he will need to choose between the TCPP and inflation-linked annuity. It is argued that the level annuity should rather be considered by older retirees with lower life expectancies. A level income in retirement seems a risky strategy in an inflationary environment if a long retirement period is envisioned.

5.2 Retiree Case 2

This section presents the results for a 60 year-old male retiree with a life expectancy of 18 years and who does not have a spouse. The analysis process is presented in the same order as Section 5.1 but is not as lengthy seeing that the analysis concepts are not explained again.

5.2.1 Present Values Analysis

From a present value analysis the results for a 60 year-old retiree do not seem to differ from a 55 year-old. The highest present value was still obtained by following the living annuity strategy with a 2.5% initial drawdown rate and an aggressive portfolio. Figures 5.11 and 5.12 depict the results.

Another aspect that should be discussed when addressing present values is the effect of compounding interest. This was briefly referred to in Section 5.1.1. Goemans and Ncube (2008) discuss the path dependence of income and the effects of having low returns in the initial years of one's retirement. This effect has a great influence on the financial success of living annuitants.

Suppose an initial investment of R100 decreases by 40% to R60. In order to make up that 40% loss one would need to earn 66,67% on the investment of R60. It is this principle that causes the underlying living annuity fund to underperform significantly when compared to other strategies that have positive growth in the initial years of investment. Furthermore, when considering the power of compound interest, one gets an even better perspective on why the performance of the underlying fund in the initial years is such a crucial element.

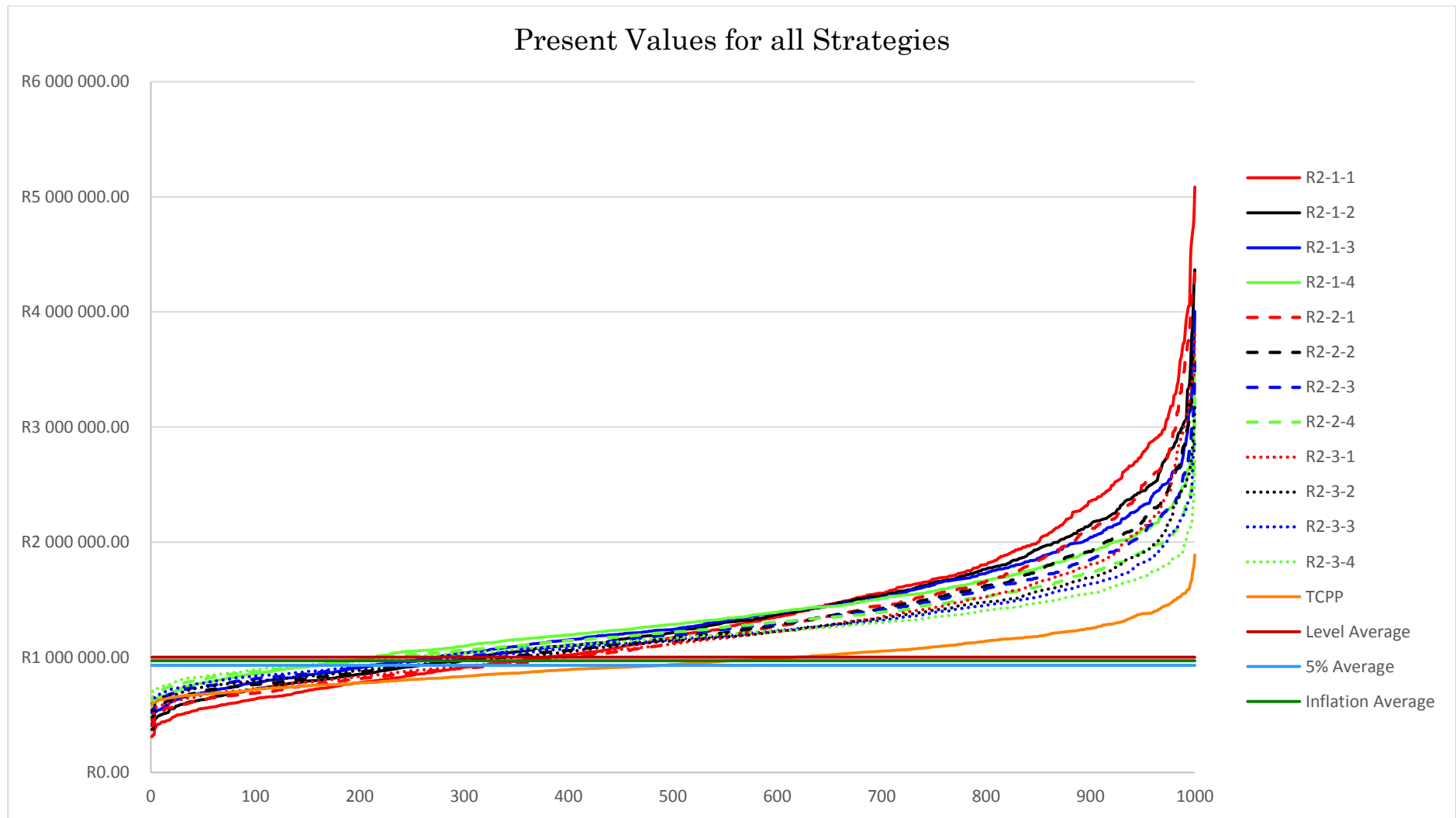


Figure 5.11: Present Values for all Strategies

Source: Author (2015)

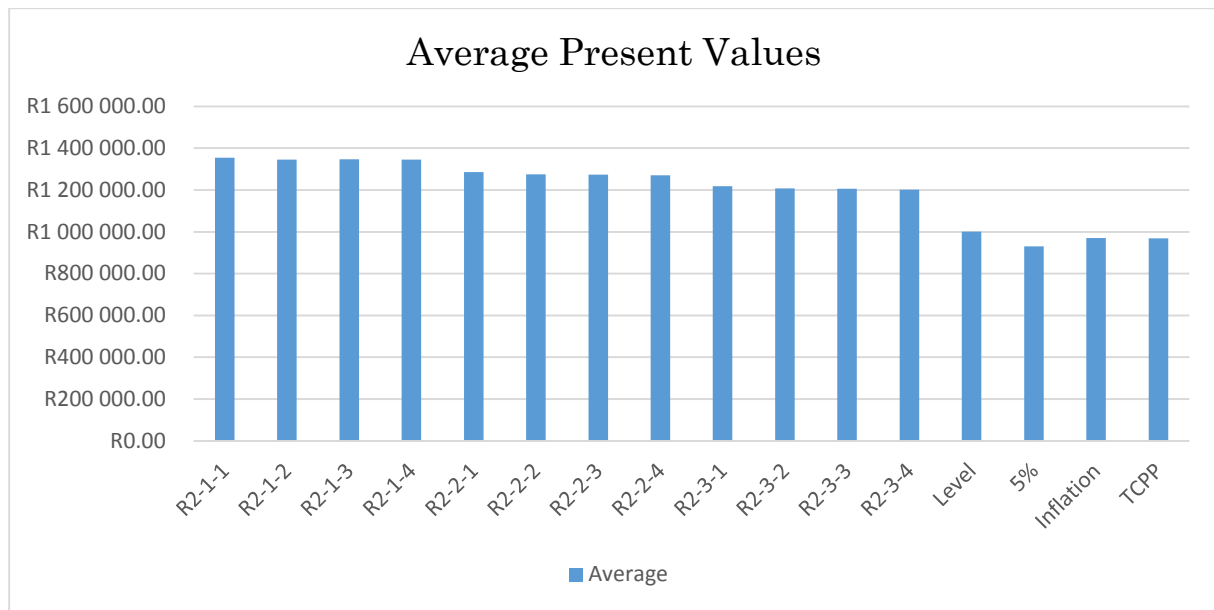


Figure 5.12: Average Present Values

Source: Author (2015)

When depicted as a bar chart the present values highlight similar results as were obtained for retiree case 1. Figure 5.12 presents the average present values in bar chart format. All living annuity strategies outperform the guaranteed annuities with the 2.5% initial drawdown strategies performing best. The level annuity is the best performing guaranteed annuity with a present value slightly higher than R1 000 000. The 5% escalating annuity is the worst performer in this case as well.

However, if one introduces a mortality shock of six years to the model the results again differ substantially. These results are presented in Figure 5.13. It is now clear that the increase in life expectancy is to the benefit of the 5% escalating, TCPP, and inflation-linked annuities. The level annuity performs worst in this case.

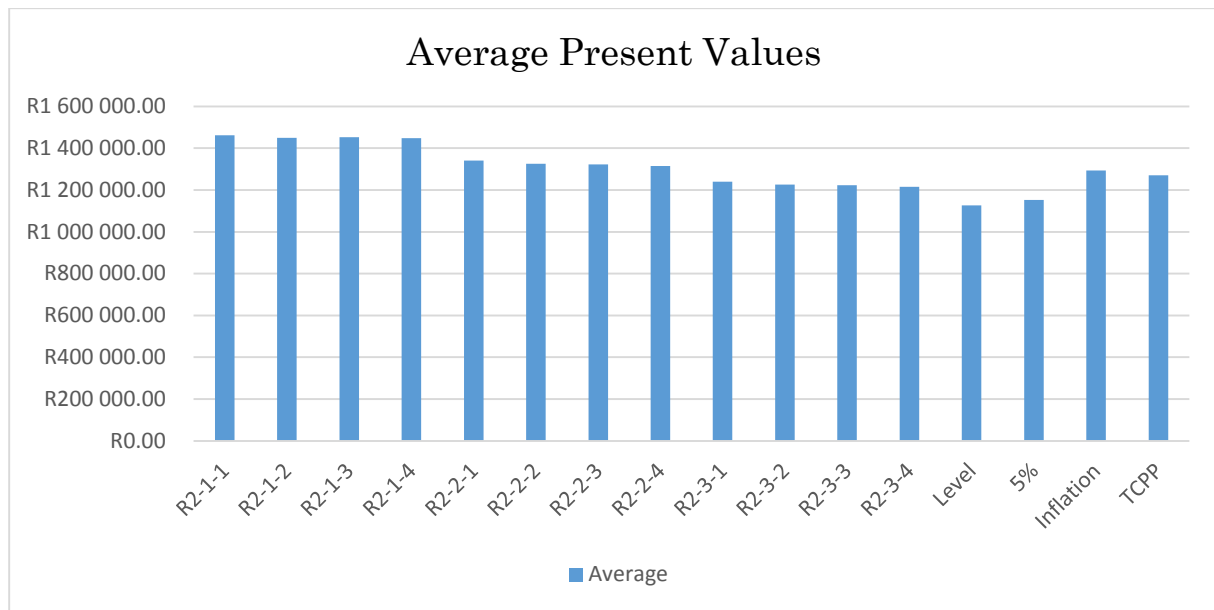


Figure 5.13: Average Present Values (increased life expectancy)

Source: Author (2015)

5.2.2 Percentile Analysis

From a percentile analysis the results still seem to favour the level annuity if upside potential is taken into account. Figure 5.14 depicts these results. It should be noted that the R1 000 000 value is located at the 43rd percentile. The inflation-linked annuity provides maximum stability around the R1 000 000 starting capital, but does not offer any upside potential. The TCPP annuity again outperforms the majority of living annuity strategies around the 40th and 60th percentiles. From a pure living annuity perspective the R2-1-4 strategy is again favoured as this provides the least amount of downside exposure with the most amount of upside exposure.

As with the previous retiree case one cannot base one's conclusion that the R2-1-4 strategy is the optimal solution on this analysis alone. Financial ruin as well as the income stream generation has to be taken into account.

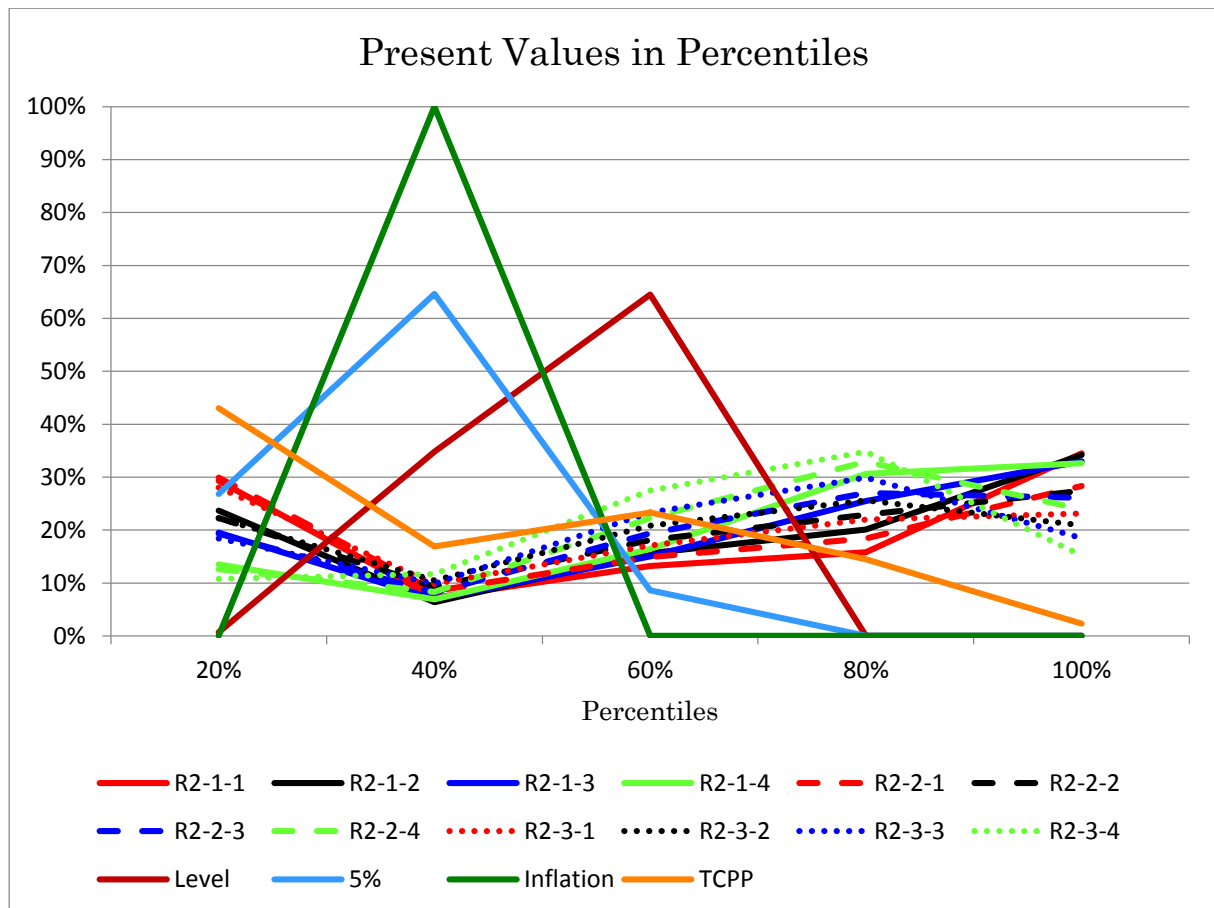


Figure 5.14: Present Values in Percentiles

Source: Author (2015)

5.2.3 Financial Ruin Analysis

This section presents the financial ruin analysis. The highest ruin probability obtained for the 2.5% initial drawdown strategies was equal to 5.3% at the expected death of the annuitant which provides further support for these strategies. Figure 5.15 depicts all the ruin percentages.

This also highlights the advantage of a shorter investment horizon. The ruin percentages are, again, divided into five intervals over the retiree's expected life. The R2-1-1 to R2-1-4 strategies provide modest ruin percentages. The R2-2-1 to R2-2-4 strategies now also seem to provide relatively safe investments with the maximum final year ruin percentage, for the aggressive asset allocation, equalling 43% at the expected end of the retiree's life. The conservative portfolio offers a final year ruin percentage of 30%. The 7.5% initial drawdown

strategies, however, still do not seem feasible with final year ruin percentages being higher than 70% at the terminal age.

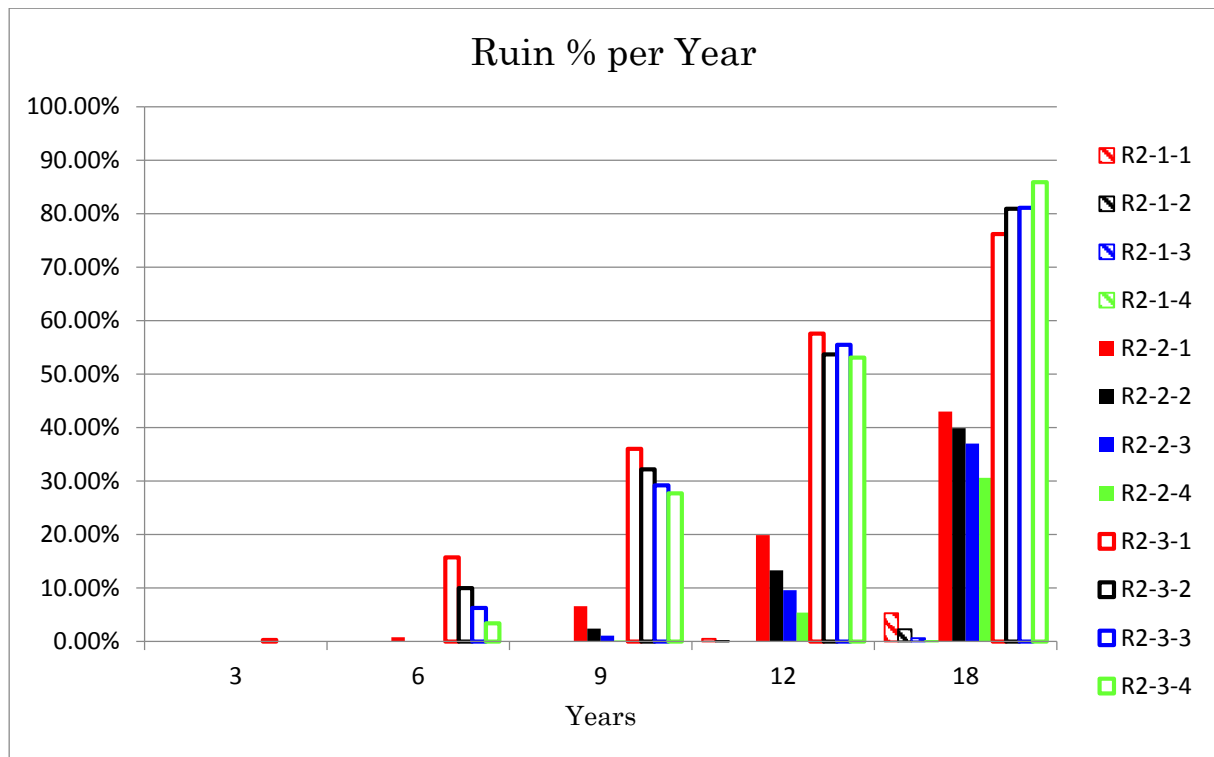


Figure 5.15: Ruin % per Year

Source: Author (2015)

5.2.4 Annuity-to-Terminal Value Analysis

An analysis of the annuity-to-terminal value ratios leads to the conclusion that a 60 year-old male living annuitant should only invest in a 5% initial drawdown strategy if he deems a terminal value of around R380 000, in present value terms, as an acceptable value to leave for his heirs. This figure is obtained by multiplying the average value from these strategies, from Figure 5.12, with the approximate terminal value ratio of 30% in Figure 5.16.

One may thus conclude that from a bequest motive point of view the 2.5% initial drawdown strategy is the optimal solution. This is regardless of asset allocation. The aggressive allocation fares worst of the four portfolios and returns 53% of the total present value in terminal value form. The 7.5% initial drawdown strategies only manage to return a maximum of 13% of the total present value in terminal value form.

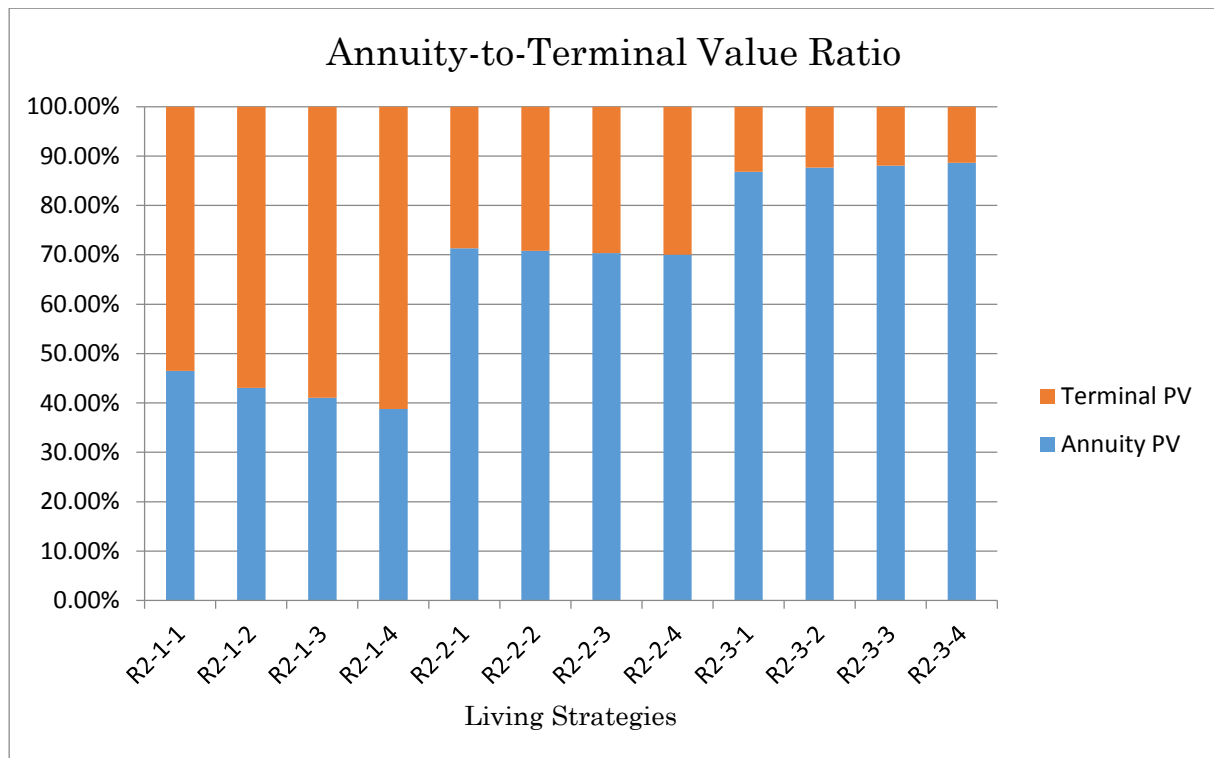


Figure 5.16: Annuity-to-Terminal Value Ratio

Source: Author (2015)

5.2.5 Probability of Outperforming Guaranteed Annuities

Figure 5.17 presents the probability of living annuities outperforming the four guaranteed annuities. The results are similar to what was obtained for a 55 year-old male retiree with no spouse. If anything, the living annuities now seem to provide a marginally higher probability of outperforming the guaranteed annuities. This is most likely due to the fact that the guaranteed annuitant now has 3 years less to live than in the case of the first retiree and thus not as long to recoup his initial investment through monthly annuities. Although the higher initial annuity (from all four guaranteed annuities) should compensate for the shorter life expectation, it is not precisely offset.

Conservative asset allocations still have the highest probability of outperformance with the largest probability equalling 85% being attributable to the R2-3-4 strategy outperforming the 5% escalating annuity. Aggressive strategies provided the lowest probability of outperformance with the lowest probability equalling approximately 60% being attributable to the R2-3-1 strategy outperforming the level annuity.

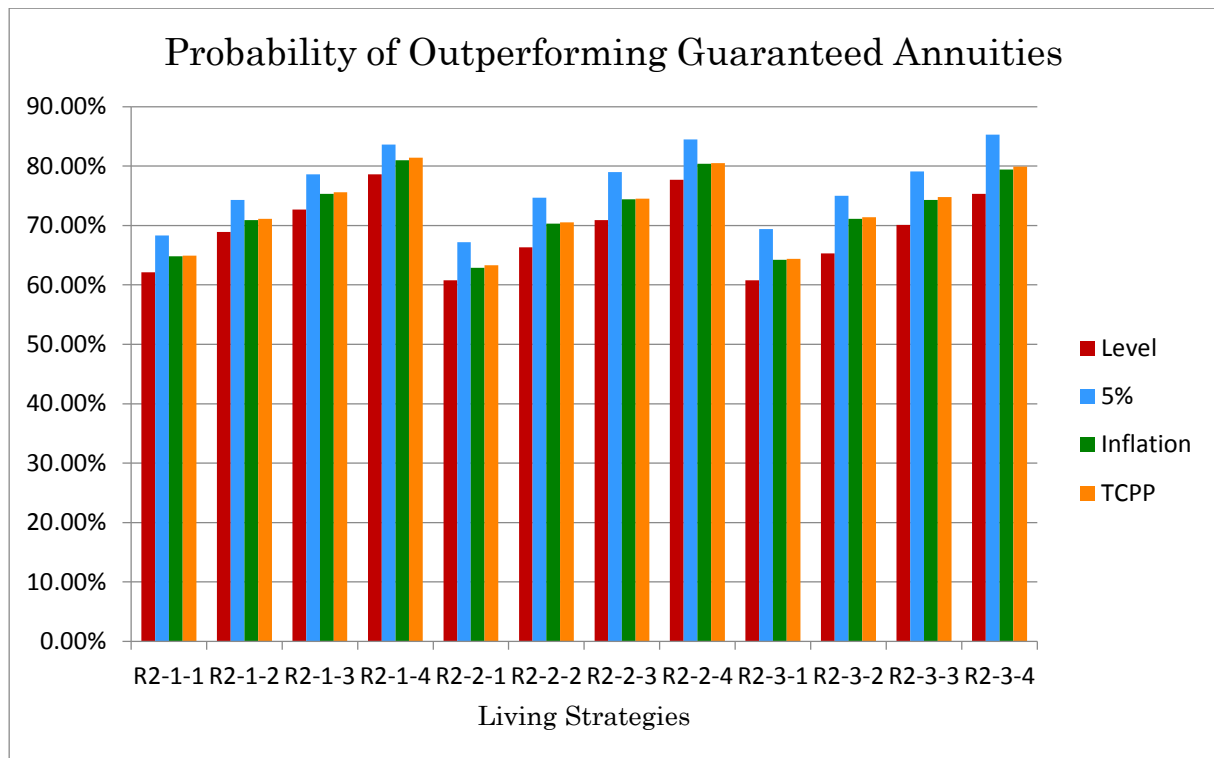


Figure 5.17: Probability of Outperforming Guaranteed Annuities

Source: Author (2015)

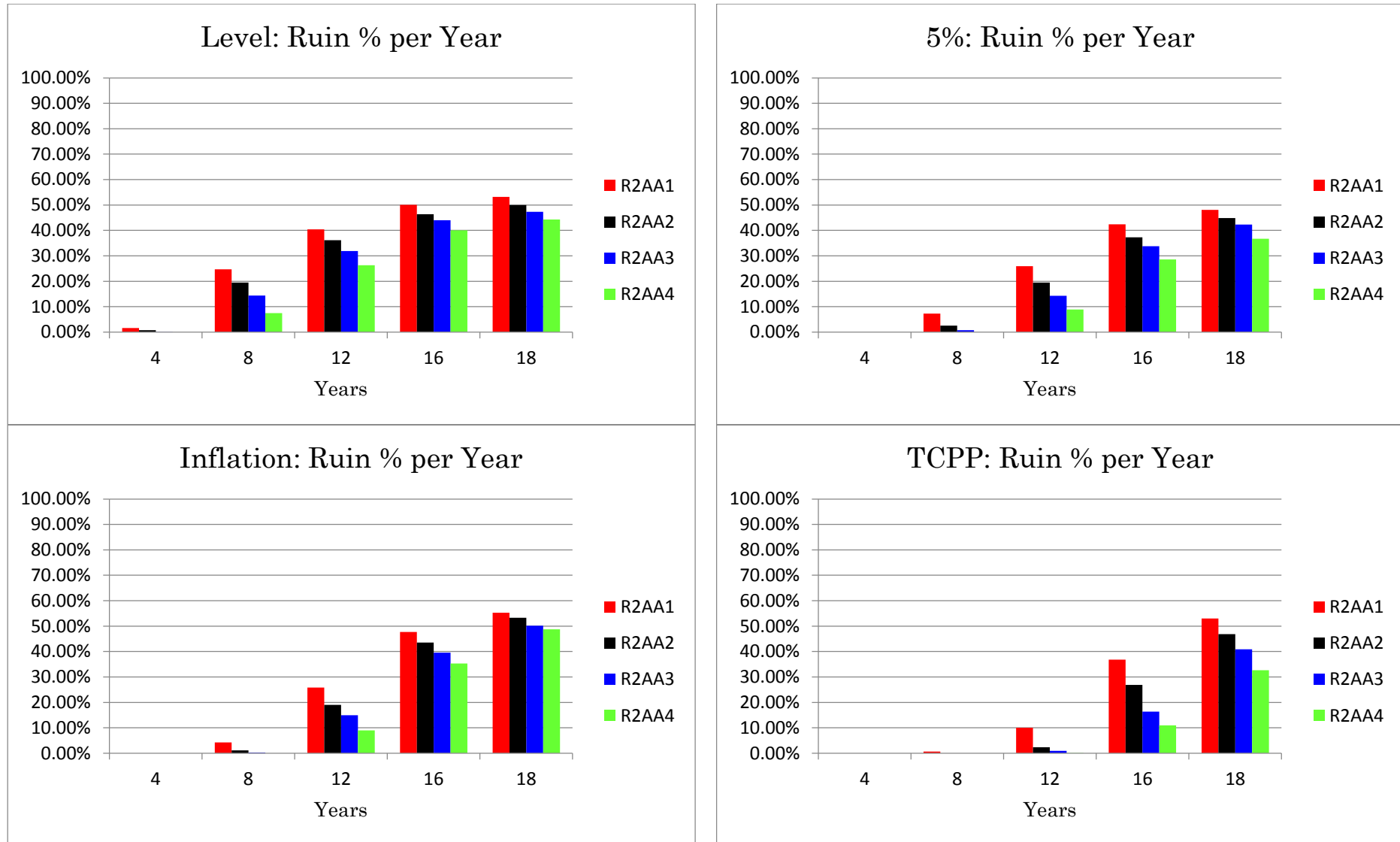
5.2.6 Annuity Replacement Model

In view of the fact that the initial annuities from each of the four guaranteed annuities are marginally higher for older retirees, which is due to their life expectancy being shorter, one would expect to see an increase in the ruin probabilities of the ARM when compared to the 55 year-old annuitant. This is indeed the case, although the underlying structure of the ruin percentages remained the same. Figure 5.18 depicts the results.

As before, the ruin percentages for each of the guaranteed annuities, and for five time intervals, are presented in this figure. The figure indicates the results under different asset allocations (AA1 to AA4) for each of the four guaranteed products. R2 refers to retiree case 2.

The level annuity replacement portfolio still has a high ruin probability in the first eight years due to its high initial annuity. The income structure from the TCPP annuity seems to be the most sustainable option within a living annuity portfolio. This is most likely due to the fact that the TCPP annuities themselves are dependent on market returns.

The results lead to the conclusion that a 60 year-old living annuitant must assume a ruin probability of 35% to 55% if he wants to achieve the same level of income as a guaranteed annuitant.

**Figure 5.18: Ruin % per Year**

Source: Author (2015)

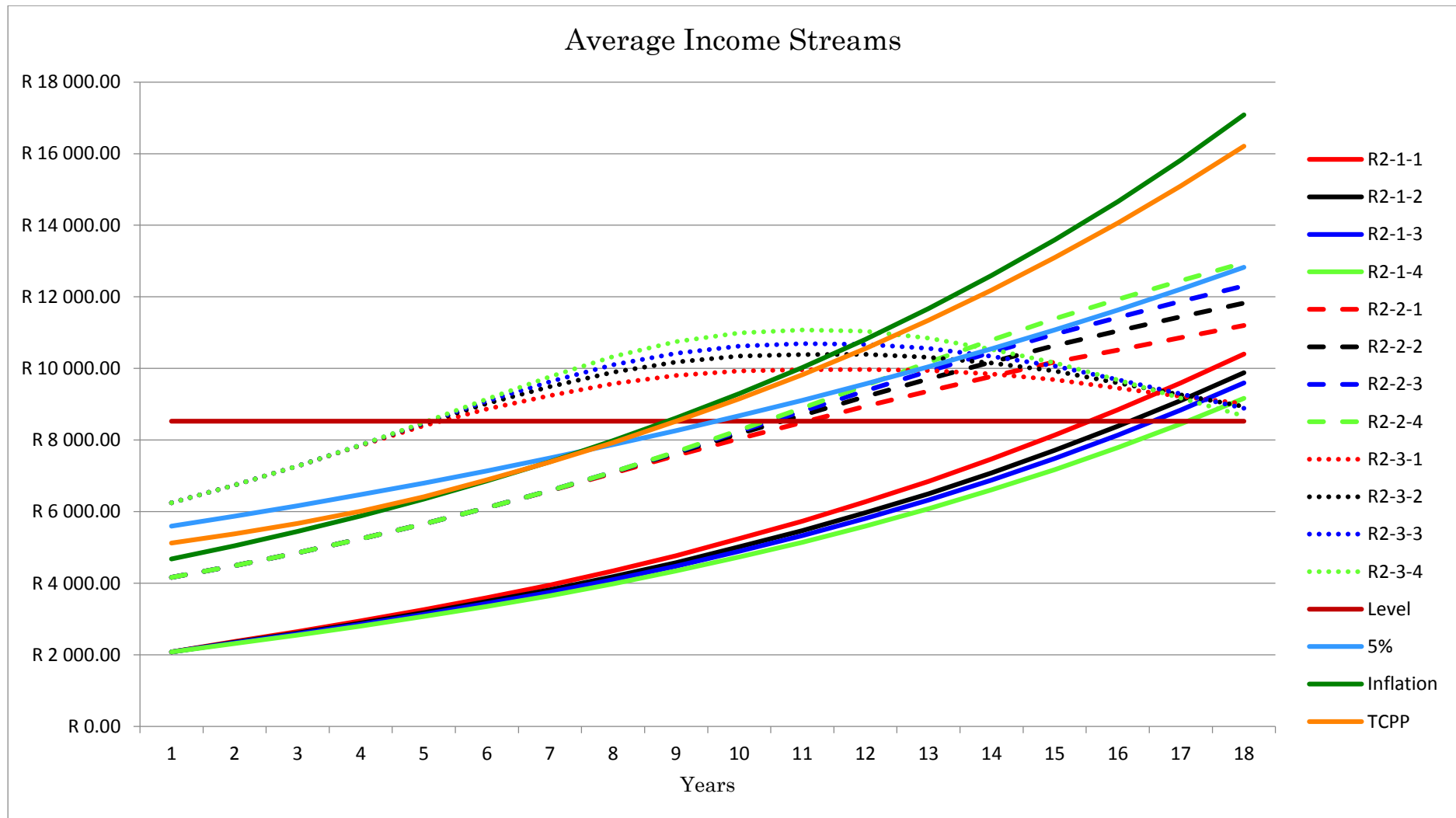
5.2.7 Income Stream Comparison

This section deals with the average monthly income levels received by the annuitant during his life. Figure 5.19 depicts the income streams if an average life expectancy is assumed. A mortality shock is again introduced in Figure 5.20 where the life expectancy is prolonged by six years.

When analysing the average income streams under average life expectancy conditions, one can see that the TCPP and inflation-linked annuities have the highest income streams after 13 years. It is important to note that they do not provide the highest average *guaranteed* present value as per Figure 5.12. The level annuity provides this option. Based on this analysis one would be able to conclude that a 60 year-old male retiree could invest in a conservative living annuity with an initial drawdown rate of 5%, assume a 26% probability of final year ruin (based on Figure 5.15), and have a competitive income stream relative to the 5% escalating annuity. At the time of expected death the annuitant would then have 30% of the total present value available to be inherited by his heirs (based on Figure 5.16).

When analysing the results from the mortality shock in Figure 5.20 one can see that the 5% initial drawdown rate living annuity strategies now fall out of favour. They are surpassed by the 2.5% strategies and seeing that a longer life expectancy is now assumed they will also have ruin probabilities significantly higher than 26%.

The inflation-linked and TCPP annuities are thus the superior options but it is important to note that they do not provide the annuitant with the bequest option as the living annuity does. It is again argued that the level annuity's stagnant income is not optimal for such a long retirement period, though it does provide the highest present value among the guaranteed annuity options.

**Figure 5.19: Average Income Streams**

Source: Author (2015)

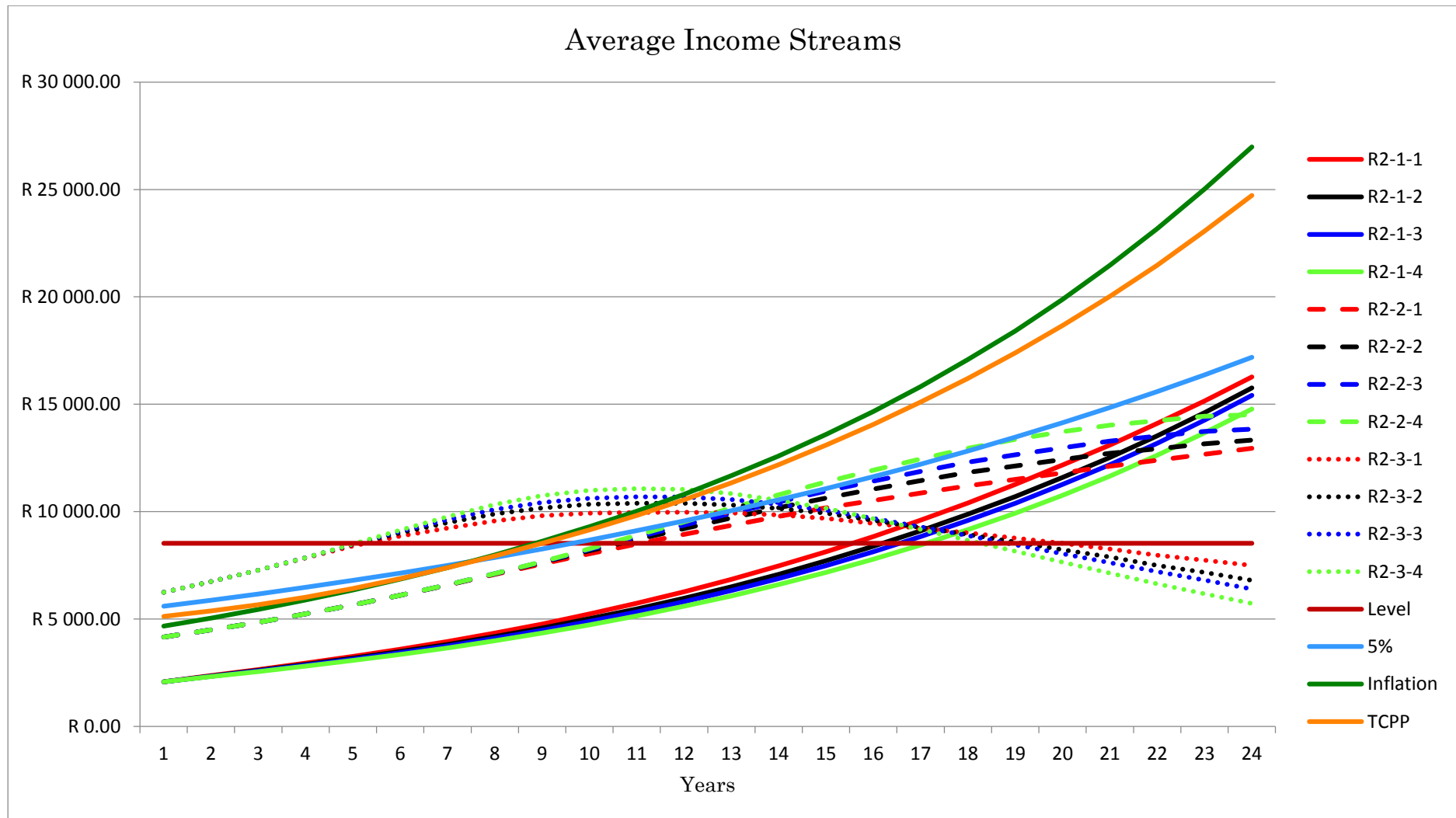


Figure 5.20: Average Income Streams (increased life expectancy)

Source: Author (2015)

5.2.8 Conclusion

From the preceding analysis it is possible to conclude that a 60 year-old male could consider a conservative living annuity with a 5% initial drawdown strategy and increase his income by the previous year's inflation rate. This would provide him with a relatively competitive income stream at a 26% probability of final year financial ruin. However, he is faced with a problem if he lives longer than the average life expectancy.

The level annuity would provide the greatest present value of the four guaranteed annuities, but it has a drawback in the sense that its income stream is only greater than the other guaranteed products for the first nine years. Thereafter the other products start to outperform the level annuity. If the retiree can manage and adapt his standard of living he could potentially opt for the level annuity. However, the TCPP and inflation-linked annuity do seem to be the better options when future income streams are considered.

5.3 Retiree Case 3

This section presents the results for a 65 year-old male retiree with no spouse and an average life expectancy of 14 years. The section follows the same structure as the preceding retiree sections.

5.3.1 Present Values Analysis

An analysis of the average present values, as per Figure 5.21, shows that the level, 5% escalating, and inflation-linked annuities failed to return the R1 000 000 initial investment. Figure 5.22 shows that the TCPP also fails to provide this initial investment when solely looking at average values. What is clear from Figure 5.21 is that the living annuities now also provide less upside potential as the investment horizon for a 65 year-old is shorter than in the previous two instances. No new information could be gathered from an asset allocation perspective.

Based on an analysis of Figure 5.22 one would conclude that the R3-1-1 to R3-1-4 strategies are superior. The level annuity also outperforms the other guaranteed annuities in terms of present values with the 5% escalating annuity performing worst.

A trend that seems to be developing is that older annuitants receive relatively less, in present value terms, from guaranteed annuities than from living annuities.

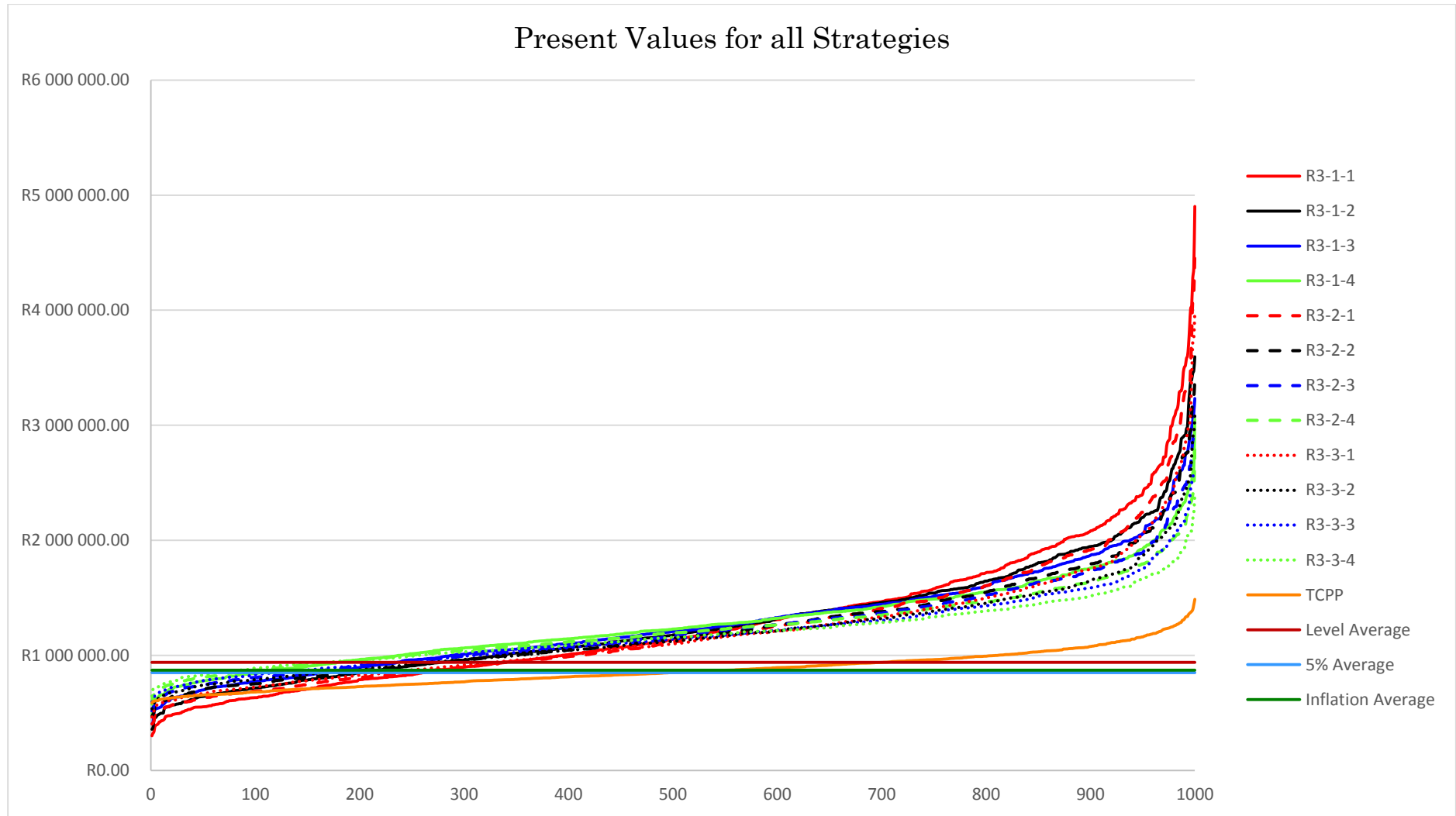


Figure 5.21: Present Values for all Strategies

Source: Author (2015)

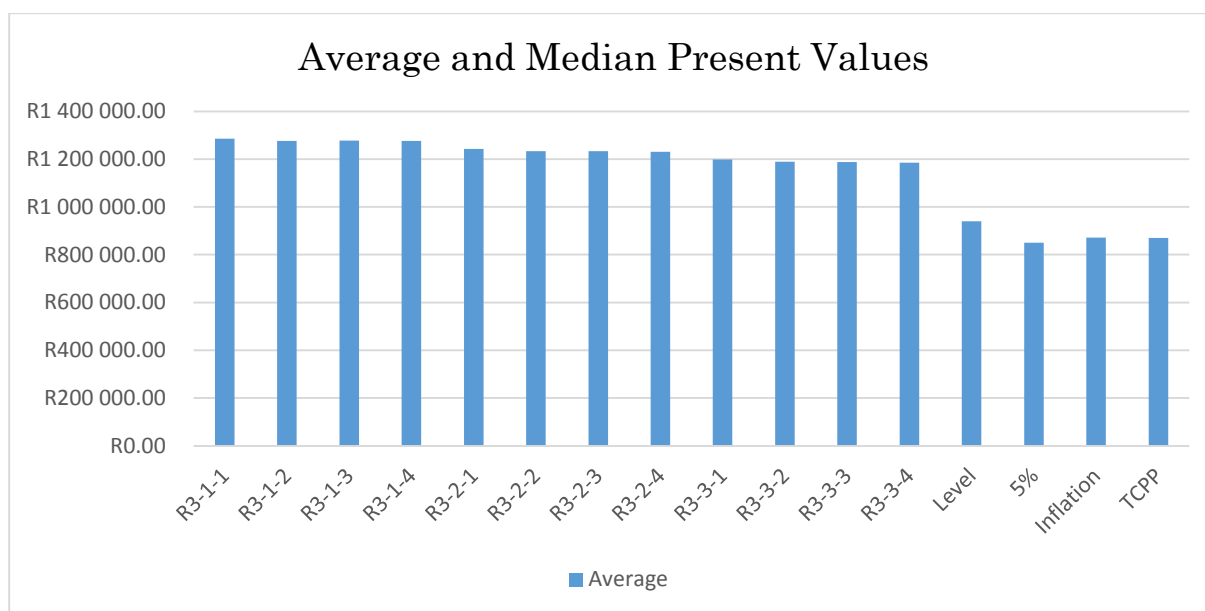


Figure 5.22: Average Present Values

Source: Author (2015)

An increase of six years in the life expectancy of the 65 year-old retiree shows that the inflation-linked and TCPP annuities become the favoured guaranteed annuity products. They offer present values that are greater than the R3-3-1 to R3-3-4 strategies. These results are presented in Figure 5.23. Based on this figure it is clear that the 5% escalating annuity again outperforms the level annuity.

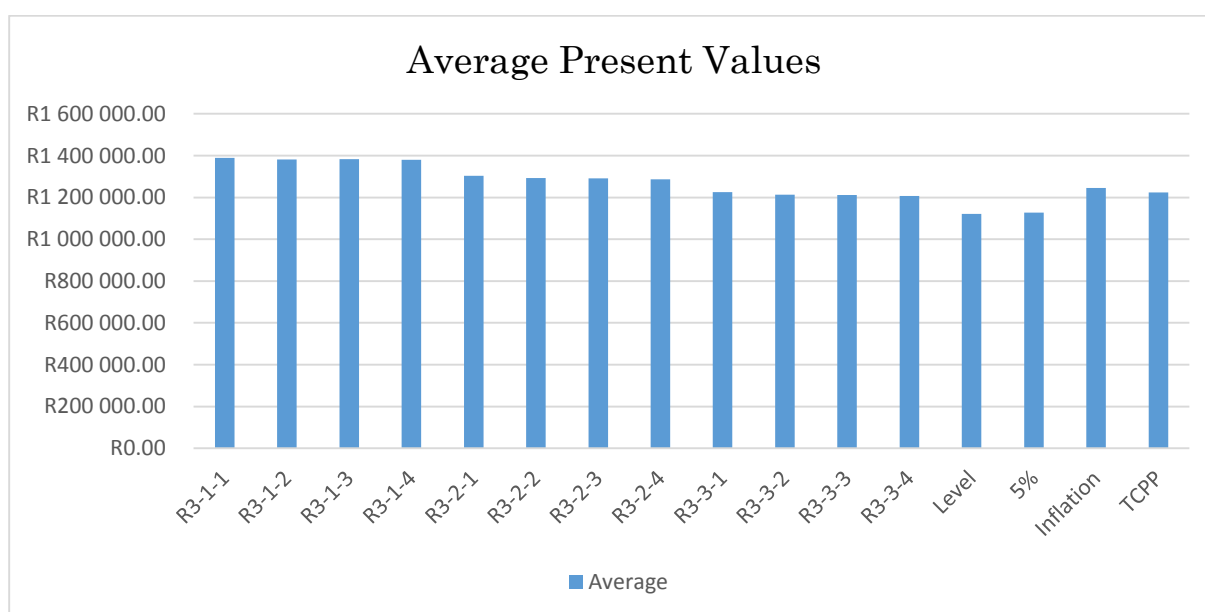


Figure 5.23: Average Present Values (increased life expectancy)

Source: Author (2015)

5.3.2 Percentile Analysis

The most notable difference from the percentile analysis, as per Figure 5.24, is that 60% of the present values of the 5% escalating annuity fall below the 20th percentile. With the R1 000 000 mark being around the 48th percentile this does prove to be a concern for such an annuitant.

The TCPP annuitant also has a relatively high number of observations below the 20th percentile but 19%, 23%, and 6% of the observations are between the 20th to 40th, the 40th to 60th, and the 60th to 80th percentiles, respectively. A more in depth analysis shows that 18.9% of all TCPP observations lie above the R1 000 000 mark, compared to the level annuity's 3.9%. The inflation-linked annuity does, however, provide some stability between the 20th and 40th percentile but it should be taken into account that the R1 000 000 value falls in the 40th to 60th percentile range.

From a living annuity perspective the R3-1-4 strategy performs best as it has, in relative terms, the lowest number of observations below the 20th percentile and the highest number of observations between the 80th and 100th percentile. This is an indication that the 65 year-old retiree should invest conservatively and start with an initial drawdown of 2.5%. The R3-3-2 or R3-3-1 strategies fared worst indicating that a 7.5% initial drawdown strategy with a moderately aggressive to aggressive portfolio would not be a suitable option for the retiree.

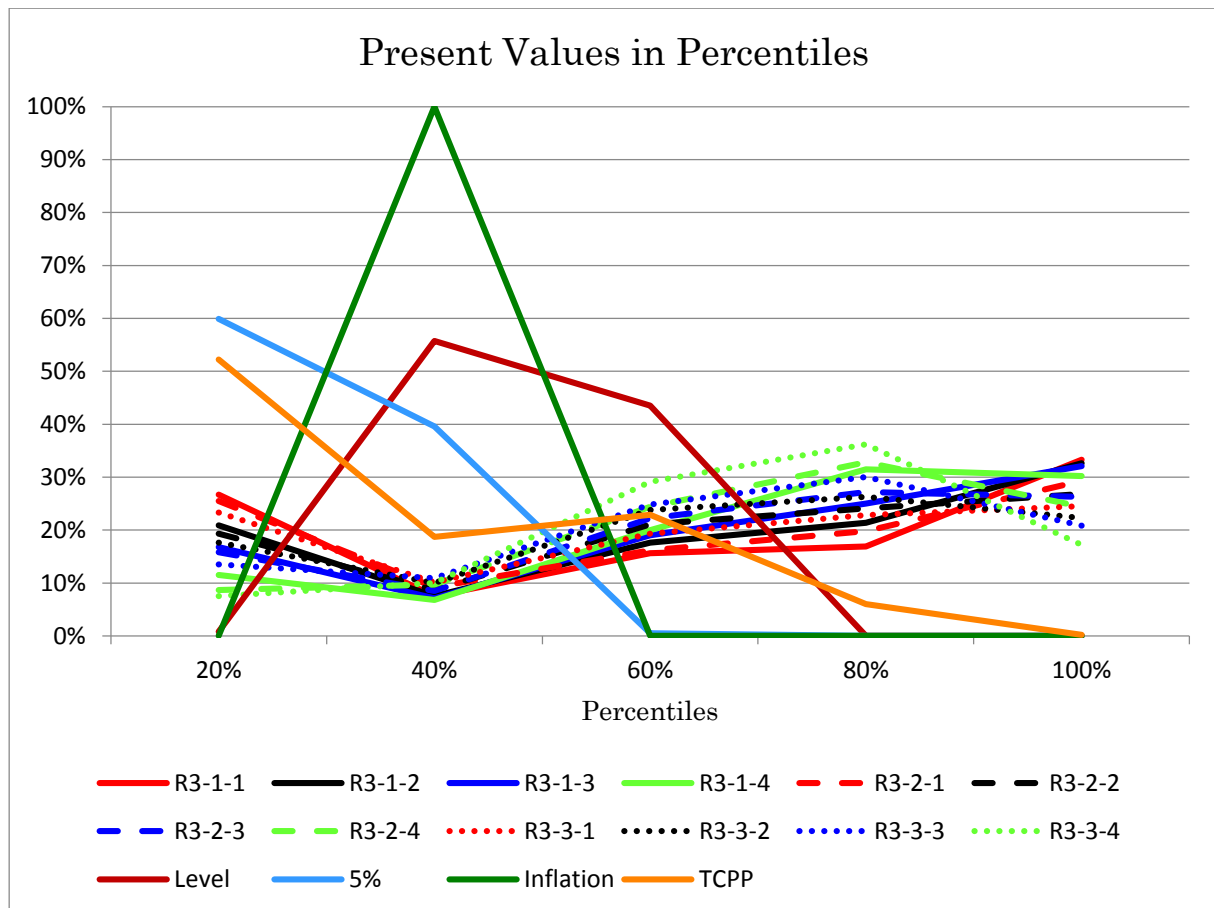


Figure 5.24: Present Values in Percentiles

Source: Author (2015)

Section 5.3.3 discusses the financial ruin analysis in order to obtain whether or not the R3-1-4 strategy will provide the optimal solution for a 65 year-old male retiree. It is argued that the R3-2-1 to R3-2-4 strategies should become more favoured as the ruin probabilities of these strategies decrease due to the shorter life expectancy of the retiree.

5.3.3 Financial Ruin Analysis

When analysing Figure 5.25 one can see that the 2.5% initial drawdown strategies outperform the other strategies by a significant margin. The strategies barely have any probability of ruin at the time of the annuitant's death. The 5% initial drawdown strategies also come into favour if one considers a final year ruin probability between 15% and 32% as acceptable. Conservative asset allocations are the most attractive options in the case of the two lower

initial drawdown strategies, but are less attractive in later years in the case of the 7.5% initial drawdown strategy.

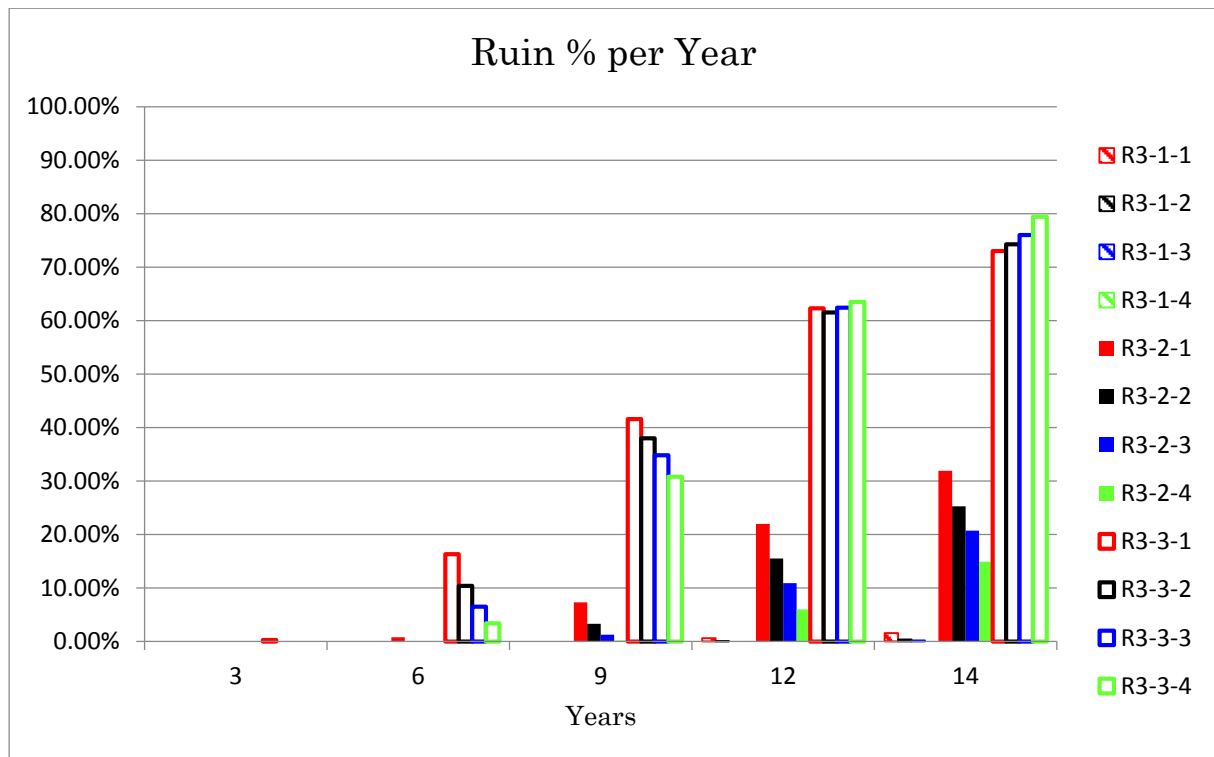


Figure 5.25: Ruin % per Year

Source: Author (2015)

5.3.4 Annuity-to-Terminal Value Analysis

As was established in the preceding sections a living annuitant might consider either the R3-1-1 to R3-1-4 or R3-2-1 to R3-2-4 strategies as a viable option in retirement. The strategies provide relatively low ruin probabilities and have favourable percentile structures. To further strengthen the case for these strategies it is also clear from Figure 5.26 that they provide a large incentive when the bequest motive is analysed.

The 2.5% initial drawdown strategies deliver 63%, 66%, 67%, and 69% in terminal values as a percentage of the total present value earned for aggressive to conservative portfolios, respectively. The 5% initial drawdown strategies, on the other hand, deliver 39%, 40%, 41%, and 42% in terminal value form as a percentage of the total present value earned for aggressive to conservative portfolios, respectively. These percentages make these strategies

more appealing as they now offer a significant monetary value to be inherited by the living annuitant's heirs.

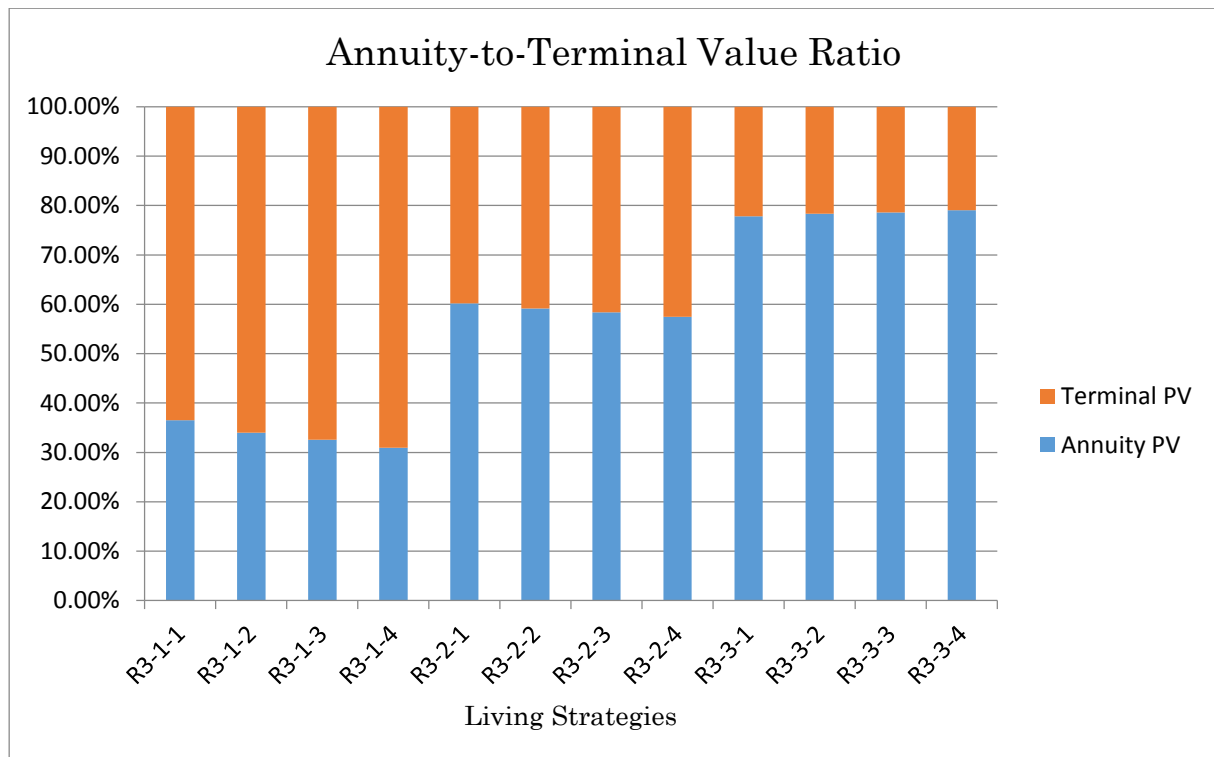


Figure 5.26: Annuity-to-Terminal Value Ratio

Source: Author (2015)

5.3.5 Probability of Outperforming Guaranteed Annuities

When comparing the outperformance probability of the living annuity relative to the guaranteed annuities one can see that each of the living annuity strategies, regardless of drawdown rate or asset allocation, has an outperformance probability greater than 66%. This is irrespective of the type of guaranteed annuity. Figure 5.27 depicts these results.

The conservative allocation strategies have the highest probability of outperforming the 5% escalating annuity. The greatest outperformance probability is approximately 92%. The level annuity still seems the most difficult to outperform as the living annuity strategies only show an 82% outperformance probability when a conservative portfolio is followed. This figure decreases to 66% when an aggressive portfolio is followed. The TCP and inflation-linked annuities are closely matched in terms of outperformance probabilities.

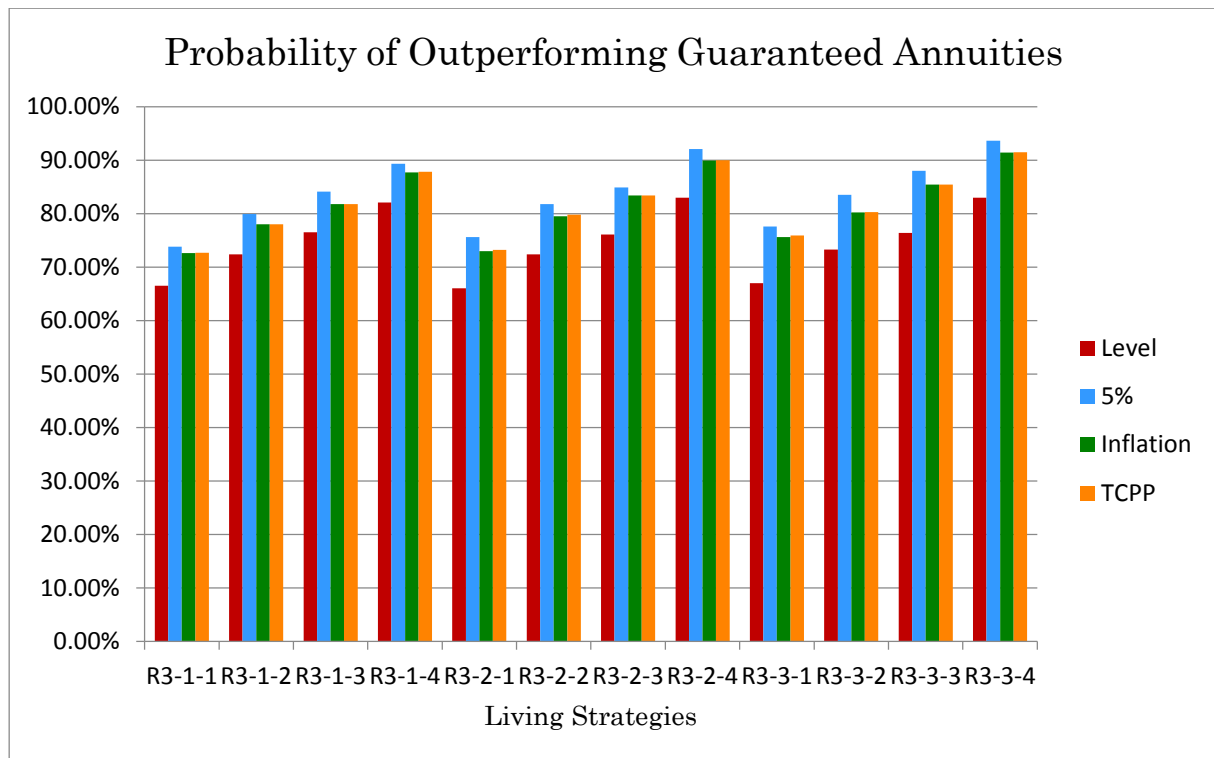


Figure 5.27: Probability of Outperforming Guaranteed Annuities

Source: Author (2015)

5.3.6 Annuity Replacement Model

The ARM, as in the previous retiree cases, depicts what the probability of ruin would be for living annuity portfolios that simulated the actual annuities paid by the various guaranteed annuities. Figure 5.28 depicts the results for a 65 year-old male retiree and is structured in five time intervals over the retiree's life. What is clear from the figure, and a reason for concern, is that a living annuity portfolio paying out an amount equal to the level guaranteed annuity already shows ruin probabilities as early as year 3.

When comparing each of the final year ruin percentages one can conclude that while most replacement portfolios have more or less the same ruin percentages, it is clear that the TCPP conservative portfolio is the most sustainable with a ruin probability of 26%. This is in comparison with the other replacement annuity products' probabilities which range from 35% to 47%. The results are an indication of the guaranteed annuity outperformance, i.e. a living annuitant would have to assume a final year ruin probability of at least 26% if he wants the same income as a TCPP annuitant – which is his best option.

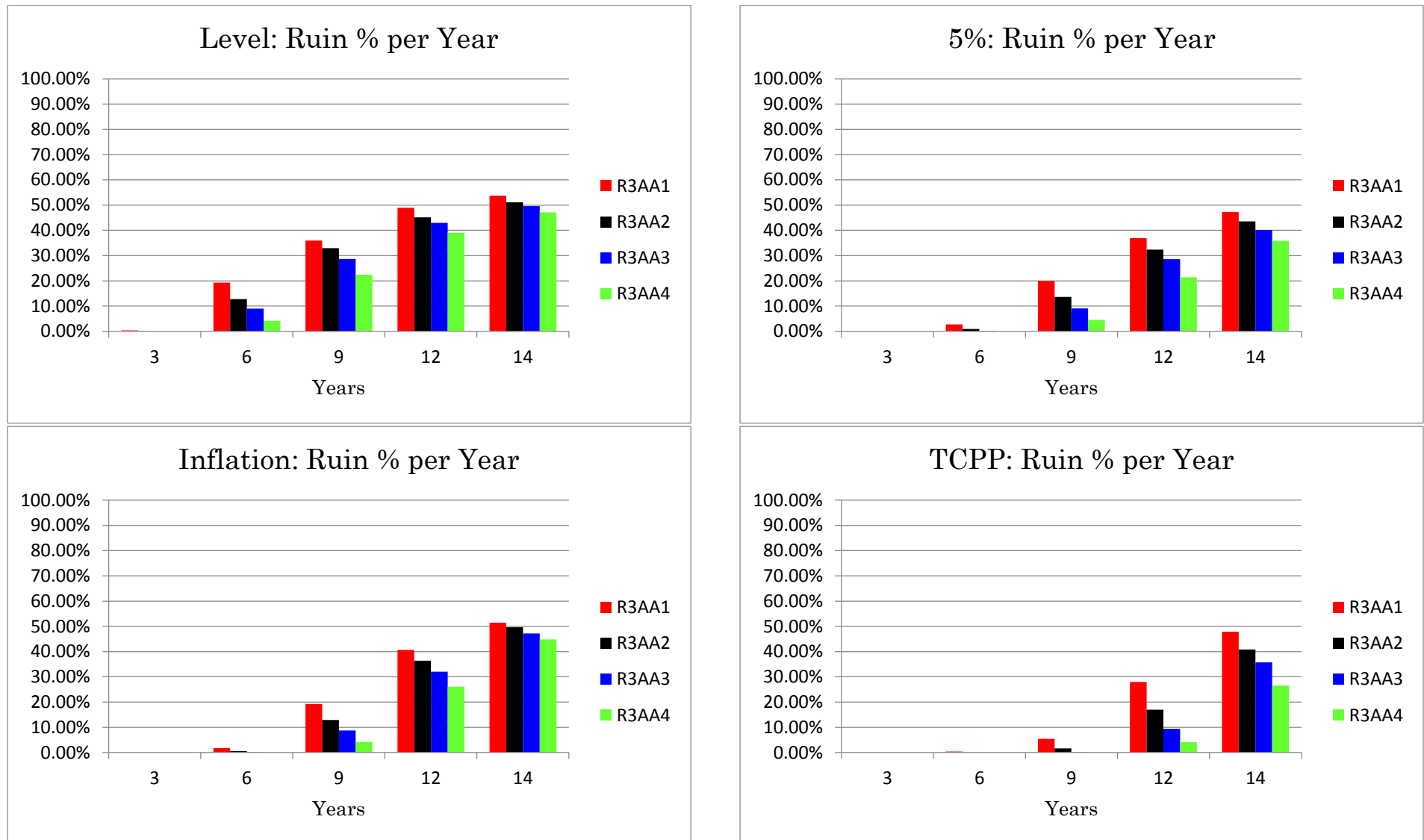


Figure 5.28: Ruin % per Year

Source: Author (2015)

5.3.7 Income Stream Comparison

The likelihood of following any of the eight living annuity strategies in respect of initial drawdown rates of 2.5% and 5% decreases when one considers monthly income streams. With the average life expectancy of a 65 year-old male equal to 14 years it is clear from Figure 5.29 that the R3-1-1 to R3-1-4 strategies deliver the lowest annuity. This annuitant's living standard will therefore have to be significantly lower than if he followed any of the other strategies. The main selling point this strategy offers, as was indicated in Section 5.3.4, is the large lump sum of money that will be inherited by his heirs.

The strategies in respect of a 5% initial drawdown rate seem to be a better option but only start to provide an income higher than the level annuity in year 12 and fail to match any of the other guaranteed products. The strategies in respect of a 7.5% initial drawdown rate do provide a high income in retirement but start to decrease in year 11 when the retiree might need the funds most. It is argued that his health might be deteriorating at this older age and medical costs might increase. These strategies also do so at a minimum ruin probability of 71% in year 14.

The TCPP and inflation-linked annuity, as well as the 5% escalating annuity, seem to offer the most competitive income streams. It is important to remember that the level annuity did provide the highest present value of the guaranteed annuities. Should the annuitant be able to manage his living standard within the limits of this level income he may well consider this product.

When a mortality shock is introduced to the model (by means of increasing his life expectancy by six years) the 7.5% initial drawdown rate strategies fall out of favour. None of the other living annuity strategies were able to provide a competitive income. One would then have to conclude that if not solely for the bequest motive the retiree should not purchase a living annuity.

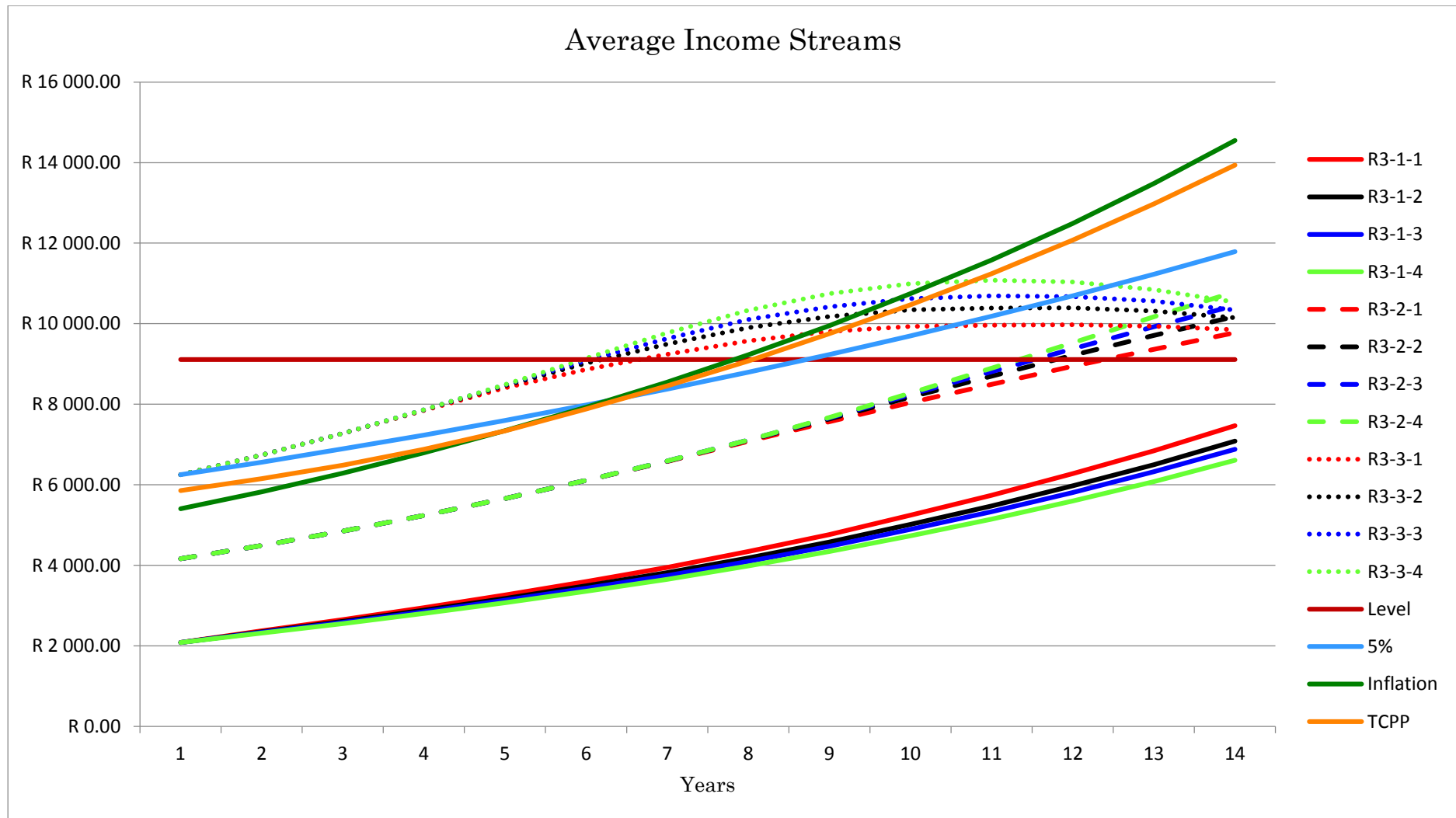


Figure 5.29: Average Income Streams

Source: Author (2015)

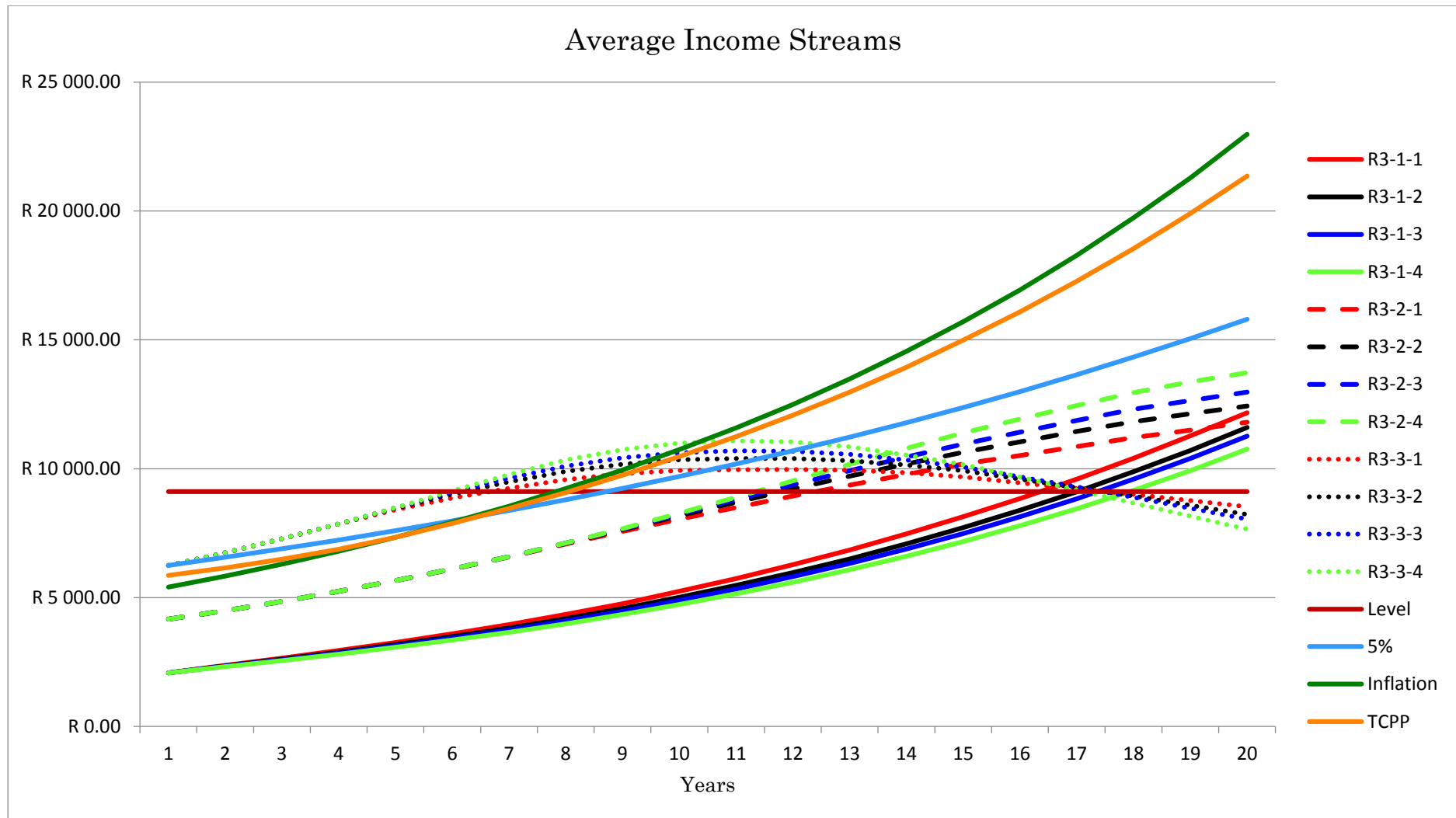


Figure 5.30: Average Income Streams (increased life expectancy)

Source: Author (2015)

5.3.8 Conclusion

From the preceding present value analysis one can conclude that a 65 year-old male retiree should only consider a living annuity strategy with an initial drawdown rate between 2.5% and 5%. This should be combined with a conservative asset allocation if he has a strong bequest motive. These strategies will, however, not provide him with a competitive income stream in comparison to guaranteed annuities but will enable him to leave an inheritance equal to between 39% and 69% of the total present value earned. This also comes at a maximum final year ruin probability of 32%.

The level annuity does provide the highest guaranteed present value, but only under average life expectancy conditions. The TCPP and inflation-linked annuities offer the most competitive income streams as they are increasing over the life of the retiree.

5.4 Retiree Case 4

This section presents the results for a 70 year-old male retiree with no spouse. His life expectancy was assumed to be 11 years. The section follows the same structure as the previous retiree sections.

5.4.1 Present Values Analysis

An analysis of the present values for this retiree case confirms the superiority of living annuities. It also confirms the superior performance of level annuities relative to the other guaranteed annuities. From Figures 5.31 and 5.32 it can be deduced that the average present value of the level annuity is some 10% higher than the inflation-linked annuity, which is the second highest ranking guaranteed annuity based on present values. The 5% escalating annuity is still the worst performer in this case.

It should be noted that the guaranteed annuities' present values are well below the R1 000 000 mark. The living annuities, on the other hand, all return average present values above the initial R1 000 000 investment. The R4-1-1 strategy, as before, is the best performer as it invests aggressively and draws the minimum initial income, thus allowing the underlying portfolio to increase significantly over time.

An interesting comparison can be made between retiree cases 1 and 4. The difference between the average present values was calculated for each annuity and is presented in Table 5.1. All these percentages are negative differences. For example, the R4-1-1 present value is 12.99% lower than the present value obtained for the R1-1-1 strategy. From this table one can conclude that the guaranteed annuities lose a lot of value the older one gets. This leads to the conclusion that retirees who are considering guaranteed annuities should annuitise sooner, rather than later. A similar result was obtained by Goemans and Ncube (2008:47). From a living annuity perspective it can be concluded that the 7.5% initial drawdown strategies do not lose as much value as the 2.5% initial drawdown strategies. This is attributable to the trend that has been developing in the previous three cases, i.e. the higher initial drawdown strategies are more sustainable over the shorter life expectancies.

Table 5.1: Average Present Value Differences

Annuity	Difference
Rx-1-1	12.99%
Rx-1-2	12.94%
Rx-1-3	12.98%
Rx-1-4	12.89%
Rx-2-1	8.92%
Rx-2-2	8.52%
Rx-2-3	8.37%
Rx-2-4	8.09%
Rx-3-1	5.92%
Rx-3-2	5.45%
Rx-3-3	5.27%
Rx-3-4	3.97%
Level	12.97%
5%	16.71%
Inflation	18.87%
TCPP	19.02%

Source: Author (2015)

Figure 5.33 depicts the average present value results when a six year increase in life expectancy is assumed. The inflation-linked and TCPP annuities again benefit significantly from this increase in life expectancy. It should also be noted that all guaranteed annuities now deliver present values greater than R1 000 000. The inflation-linked and TCPP annuities come close to matching the R3-2-1 to R3-2-4 living annuity strategies. The 5% escalating annuity is also again preferred to the level annuity.

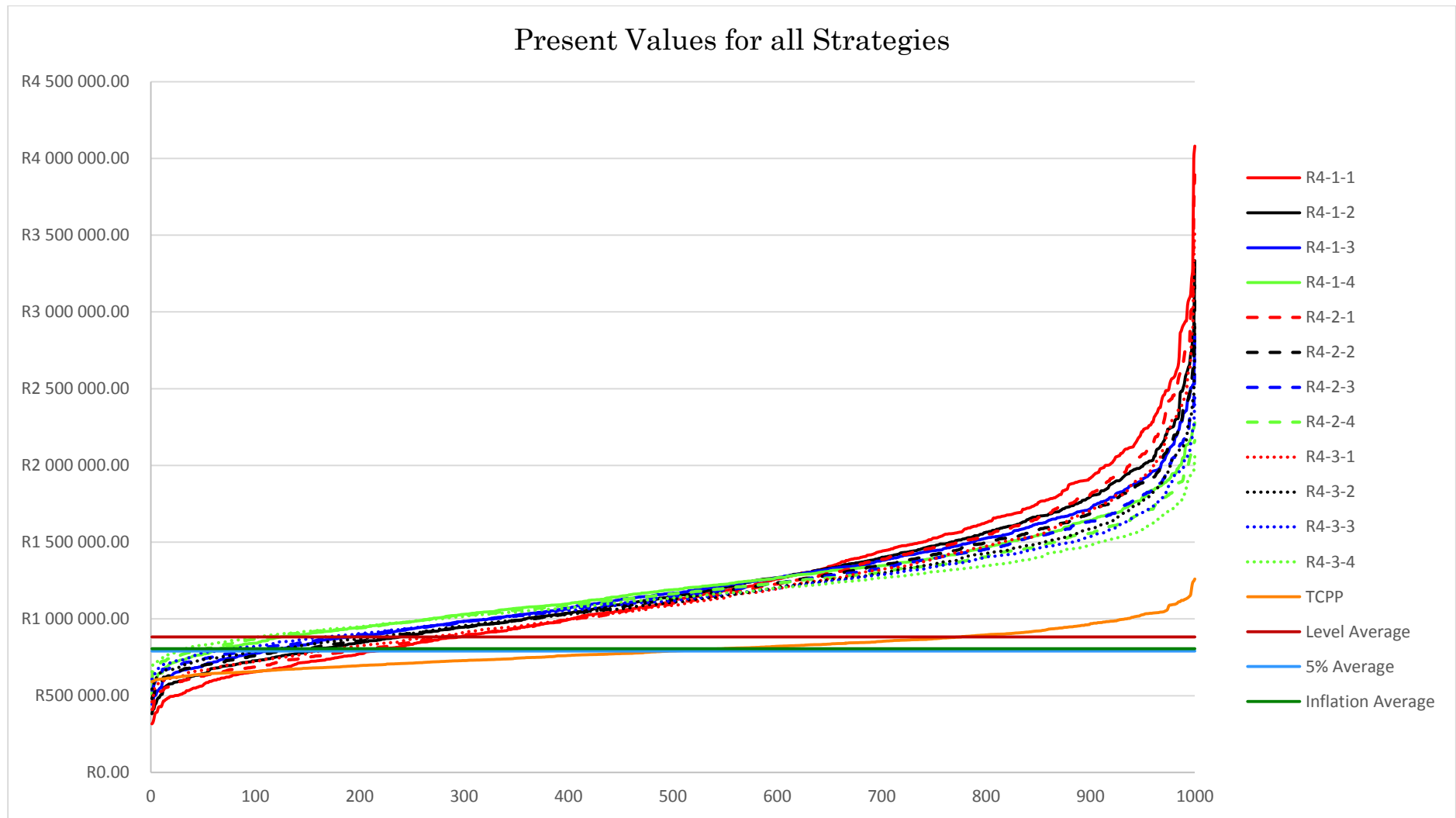


Figure 5.31: Present Values for all Strategies

Source: Author (2015)

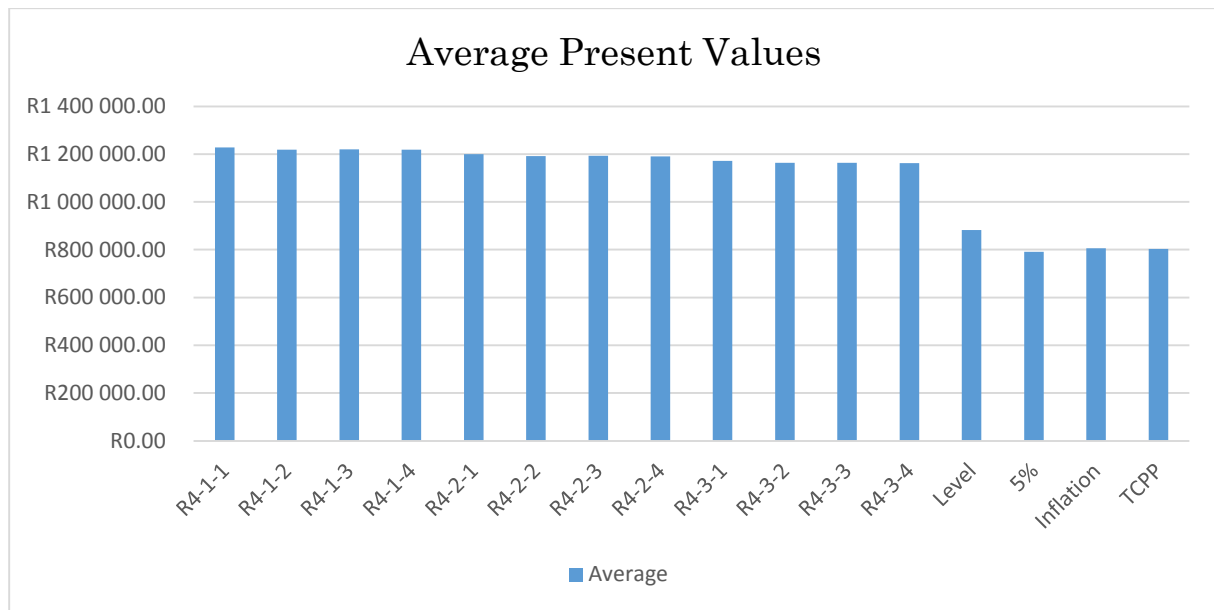


Figure 5.32: Average Present Values

Source: Author (2015)

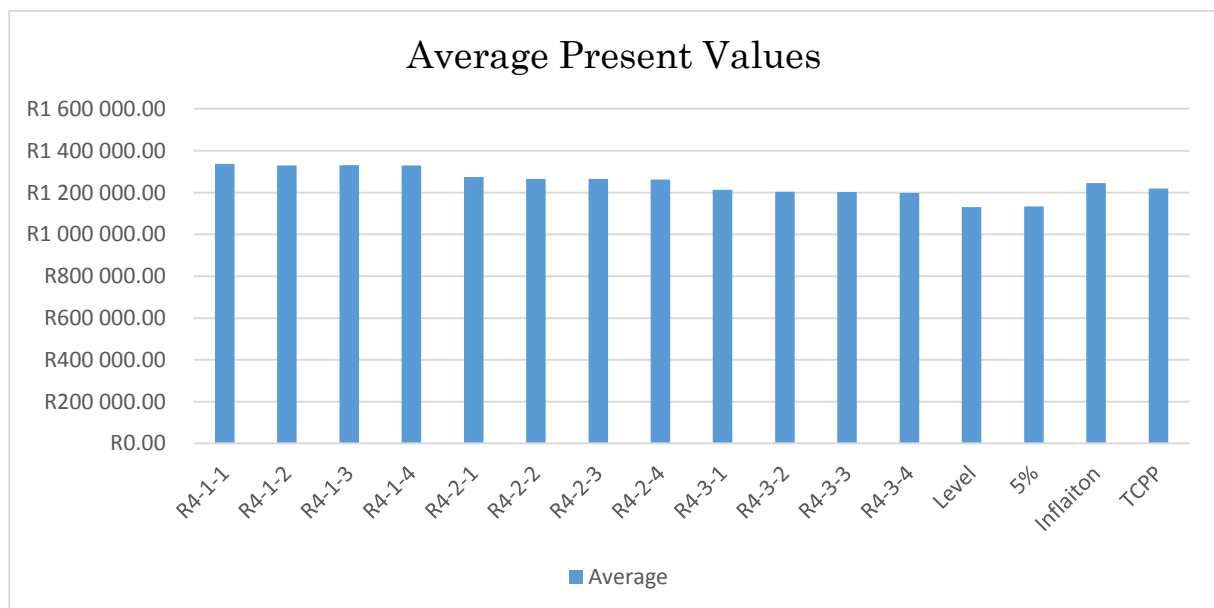


Figure 5.33: Average Present Values (increased life expectancy)

Source: Author (2015)

5.4.2 Percentile Analysis

The percentile analysis reveals that the guaranteed annuities start to fall out of favour for the 70 year-old annuitant. The R1 000 000 mark lies around the 50th percentile in Figure 5.34. One would then wish to see most of the guaranteed annuity observations in this area, but only the level and TCPP annuity have 19% and 16% of their observations in the 40th to 60th percentile range, respectively. The TCPP annuity has a further 2% of observations in the 60th to 80th percentile range. The 5% escalating annuity is the worst performer with 72% of observations below the 20th percentile and the remainder between the 20th and 40th percentiles.

From a living annuity perspective it is the R4-1-4 strategy that again outperforms the rest. Only 7% of its observations are below the 20th percentile and 27% of its observations are between the 80th and 100th percentile. One could also argue that the R4-2-4 strategy shows promise as 5% of its observations are below the 20th percentile and 22% are between the 80th and 100th percentile.

Further analyses, as conducted before, is however required to decide on the optimal strategy. The subsequent sections discuss the other measurements in the analysis process.

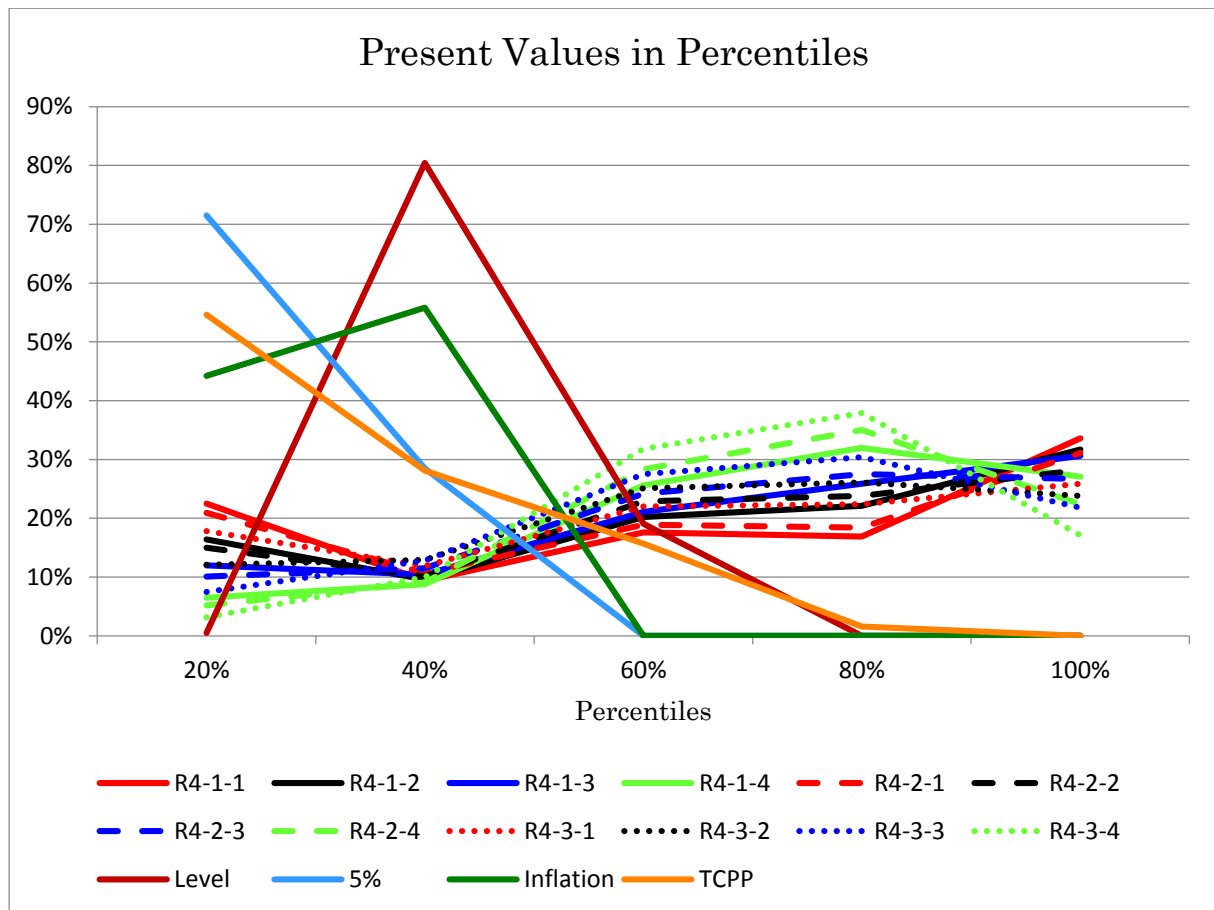


Figure 5.34: Present Values in Percentiles

Source: Author (2015)

5.4.3 Financial Ruin Analysis

Based on the ruin analysis, as per Figure 5.35, one can conclude that the 5% initial drawdown strategies now have a low enough ruin probability to be considered as safe investments. The highest ruin probability for this strategy equals 16% at the expected date of death of the retiree in the case of the aggressive portfolio. One could argue that the 54% final year ruin probability offered by R4-3-4 strategy might be acceptable to a 70 year-old retiree with an unhealthy lifestyle. As we will see in the subsequent sections this becomes an attractive retirement solution to older retirees. It is also noteworthy to mention that the 2.5% initial drawdown strategies have no ruin probability except for the aggressive portfolio which has a 0.4% probability at the expected date of death. Otherwise the 2.5% initial drawdown strategies are all financially viable options, irrespective of asset allocation. One could thus

safely invest in such a product and increase your initial income by the previous year's inflation rate. The 17.5% drawdown cap will not be reached.

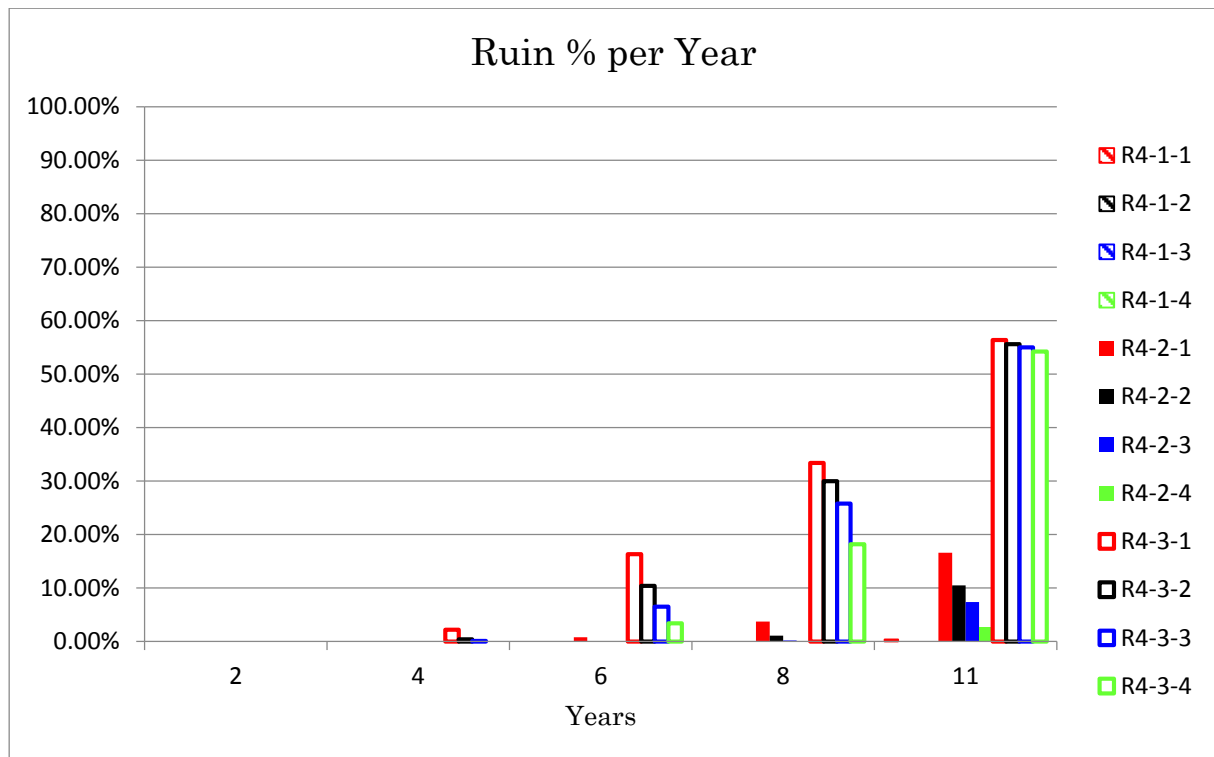


Figure 5.35: Ruin % per Year

Source: Author (2015)

5.4.4 Annuity-to-Terminal Value Analysis

When analysing the bequest motive for a 70 year-old retiree one can conclude that even the 7.5% initial drawdown strategies seem to be an attractive option as these strategies return up to 32% of total present values in terminal value form. Figure 5.36 presents these results.

75% of the total present value for the R4-1-4 strategy consists of the value remaining in the fund at the time of the retiree's death. The lifetime annuity income represents the other 25%. The 5% initial drawdown strategies provide approximately 50% of total present values in terminal value form. Conservative portfolios outperform more aggressive portfolios in all cases. However, to conclude which strategy presents the optimal investment for a 70 year-old one also has to consider the income streams provided by the annuities. Section 5.4.7 presents these results.

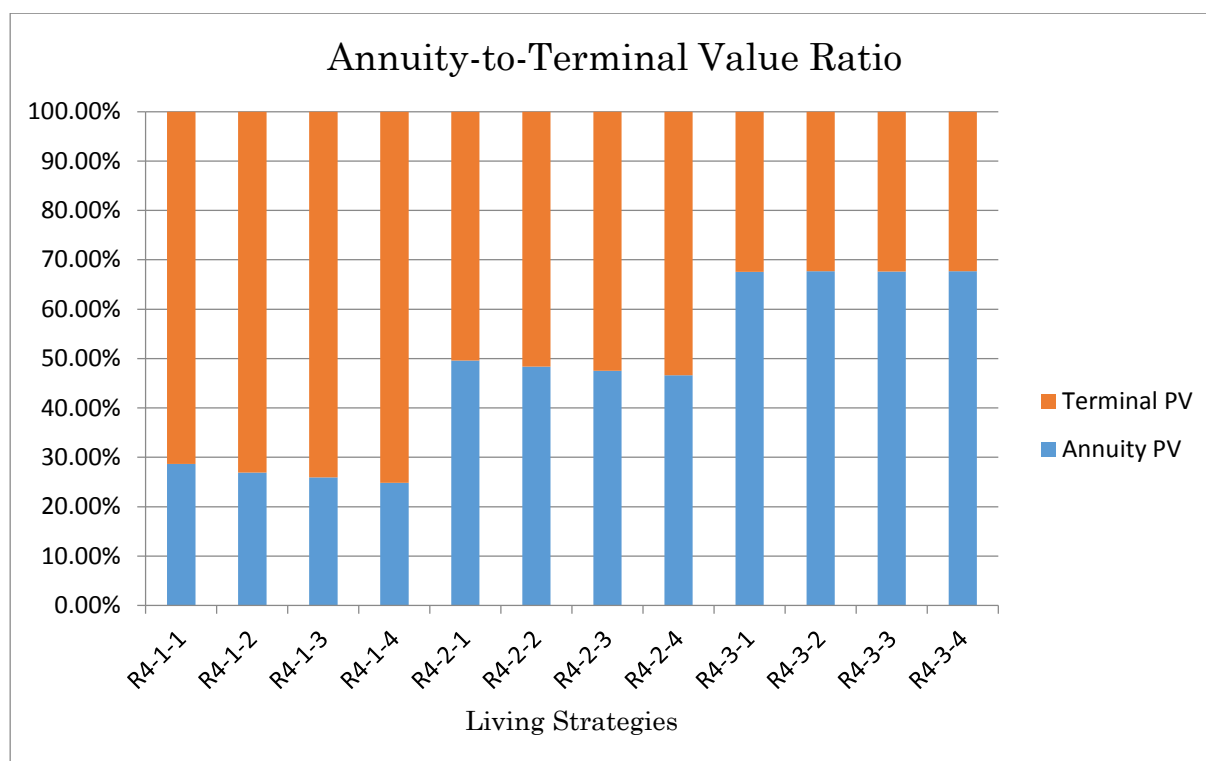


Figure 5.36: Annuity-to-Terminal Value Ratio

Source: Author (2015)

5.4.5 Probability of Outperforming Guaranteed Annuities

To provide further assistance with choosing the optimal annuity the probability of living annuities outperforming each of the guaranteed annuities was considered. As is clear from Figure 5.37 all the strategies have an outperformance probability of at least 70%. This is largely due to the lower average present values of the guaranteed annuities. The conservative portfolios perform best and have the highest probability, around 96%, of outperforming the 5% escalating annuity. The level annuity still proves the most difficult to outperform. These results do not differ materially from the 55 year-old retiree case.

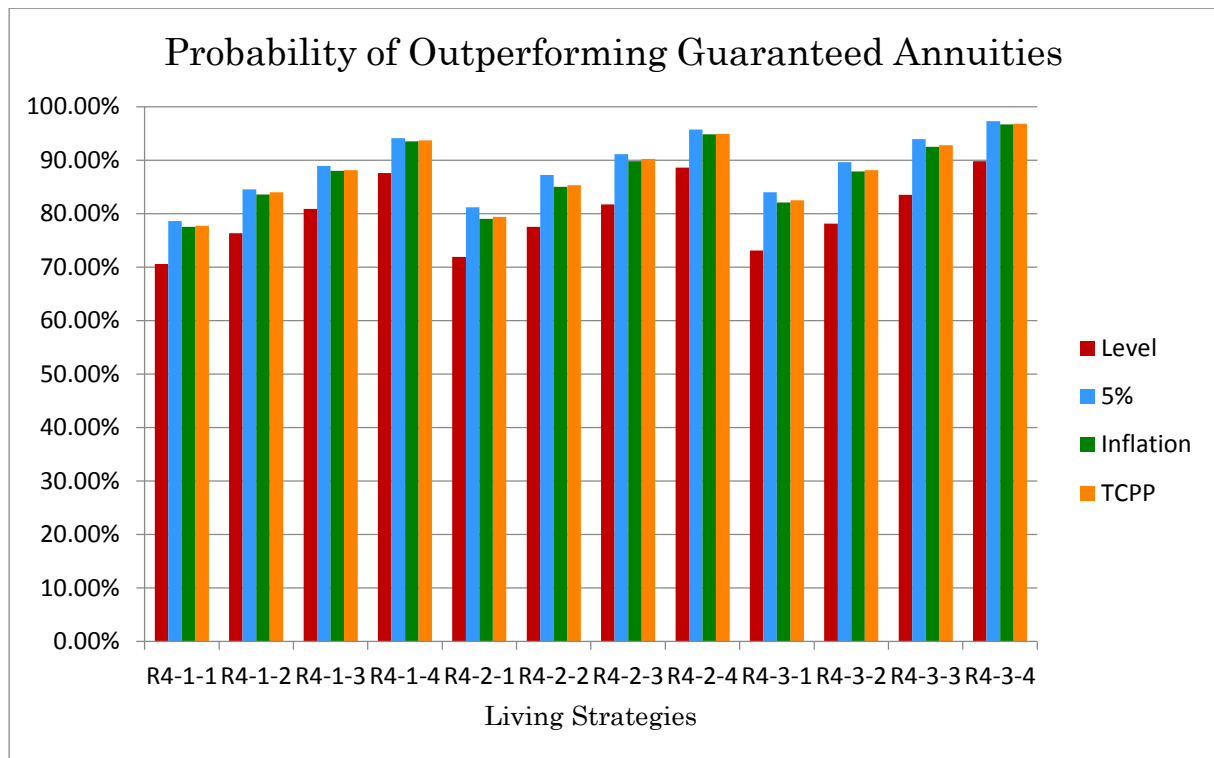


Figure 5.37: Probability of Outperforming Guaranteed Annuities

Source: Author (2015)

5.4.6 Annuity Replacement Model

The ARM was also considered for the 70 year-old retiree as additional analysis of living annuity performance relative to guaranteed annuities. The results are presented in Figure 5.38

An interesting and rather intuitive trend is evident from the analysis of this replacement model. When the ruin percentages from the replacement models for each of the guaranteed annuities across all four retiree cases are considered, the older retiree cases have somewhat higher final year ruin probabilities. This phenomenon is most likely due to the fact that the guaranteed annuities are priced and structured in such a way that they return the initial investment of the retiree over his life expectancy. The slightly higher ruin percentages compared with retiree case 1 can be attributed to the higher annuities paid out to the older retiree.

Figure 5.38 shows that conservative asset allocations fared best in providing the same level of income as the guaranteed annuities. When the averages are calculated one can conclude that

the conservative portfolios exhibit a final year ruin probability of 31% while the aggressive portfolios have an average final year ruin probability of 50%. These final year ruin probabilities are further used in subsequent sections.

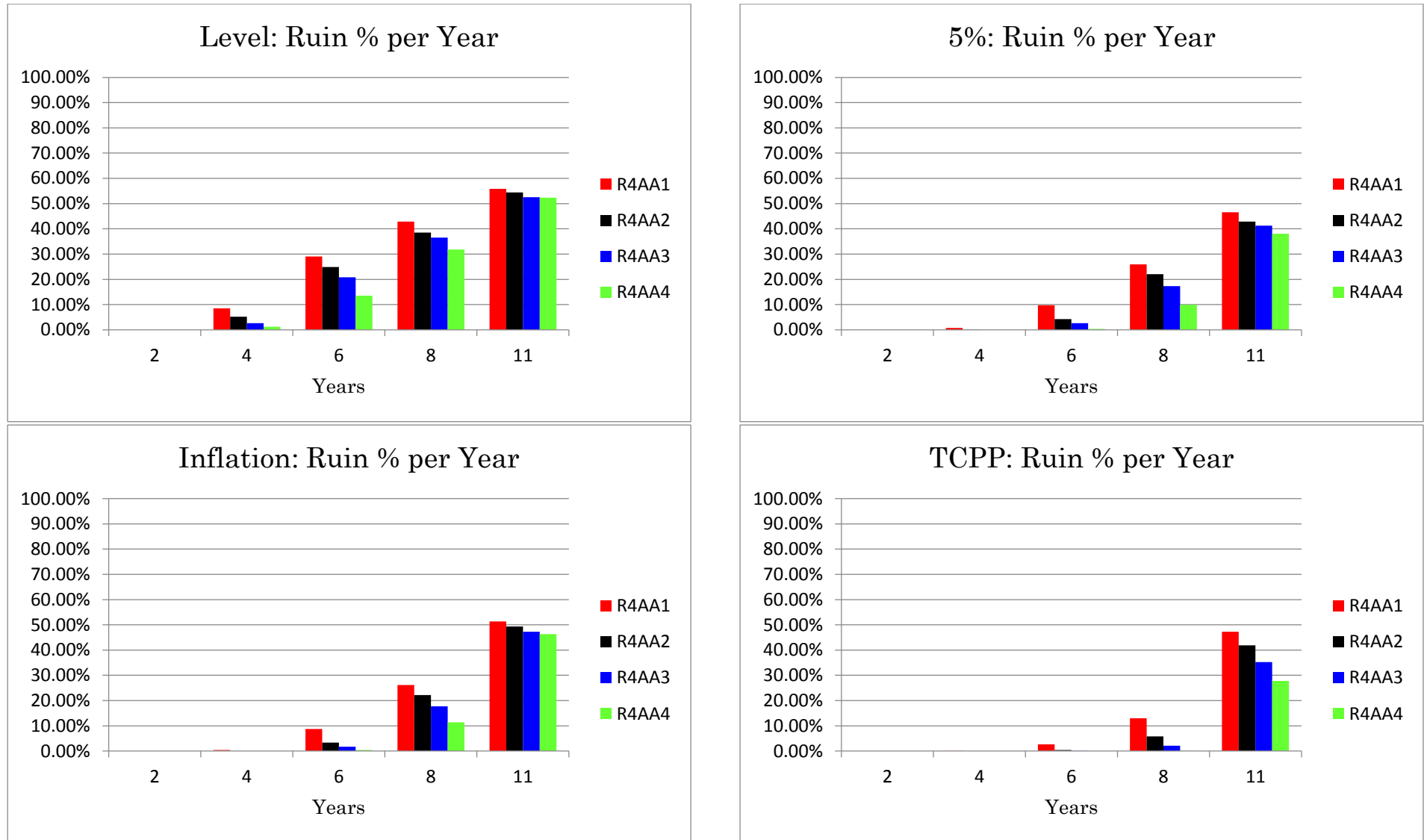


Figure 5.38: Ruin % per Year

Source: Author (2015)

5.4.7 Income Stream Comparison

Comparing the monthly income streams from the different annuities leads to perhaps the most conclusive result in the case of this 70 year-old. Figure 5.39 depicts the results given the normal life expectancy assumption. This shows that the 2.5% and 5% initial drawdown strategies do not provide an income that is in any way competitive with the other annuities.

However, the 7.5% initial drawdown strategies do provide a sufficient income stream that is indeed competitive when measured against the guaranteed annuities. The R4-3-4 strategy performs in line with the 5% escalating annuity based on average values. It does so at a final year ruin probability of 54% which might be considered high, but it also provides the possibility of returning 32% of the total present value earned in the form of a terminal value, i.e. an inheritance for the retiree's heirs. It is interesting to note that based on the ARM one could replicate the 5% escalating annuity's income within a living annuity portfolio at a maximum final year ruin probability of 46%.

It is important to note that the R4-3-4 strategy is not able to maintain this level of increasing income. This result is based on Figure 5.40 which depicts the effect of introducing a mortality shock to the model. All guaranteed annuities with increasing income streams now outperform the living annuity strategies.

The inflation-linked and TCPP annuities provide the most promising increasing income stream, but both have lower present values than the level annuity. It is argued that the average life expectancy of these older retirees is short enough that they might consider the level annuity product.

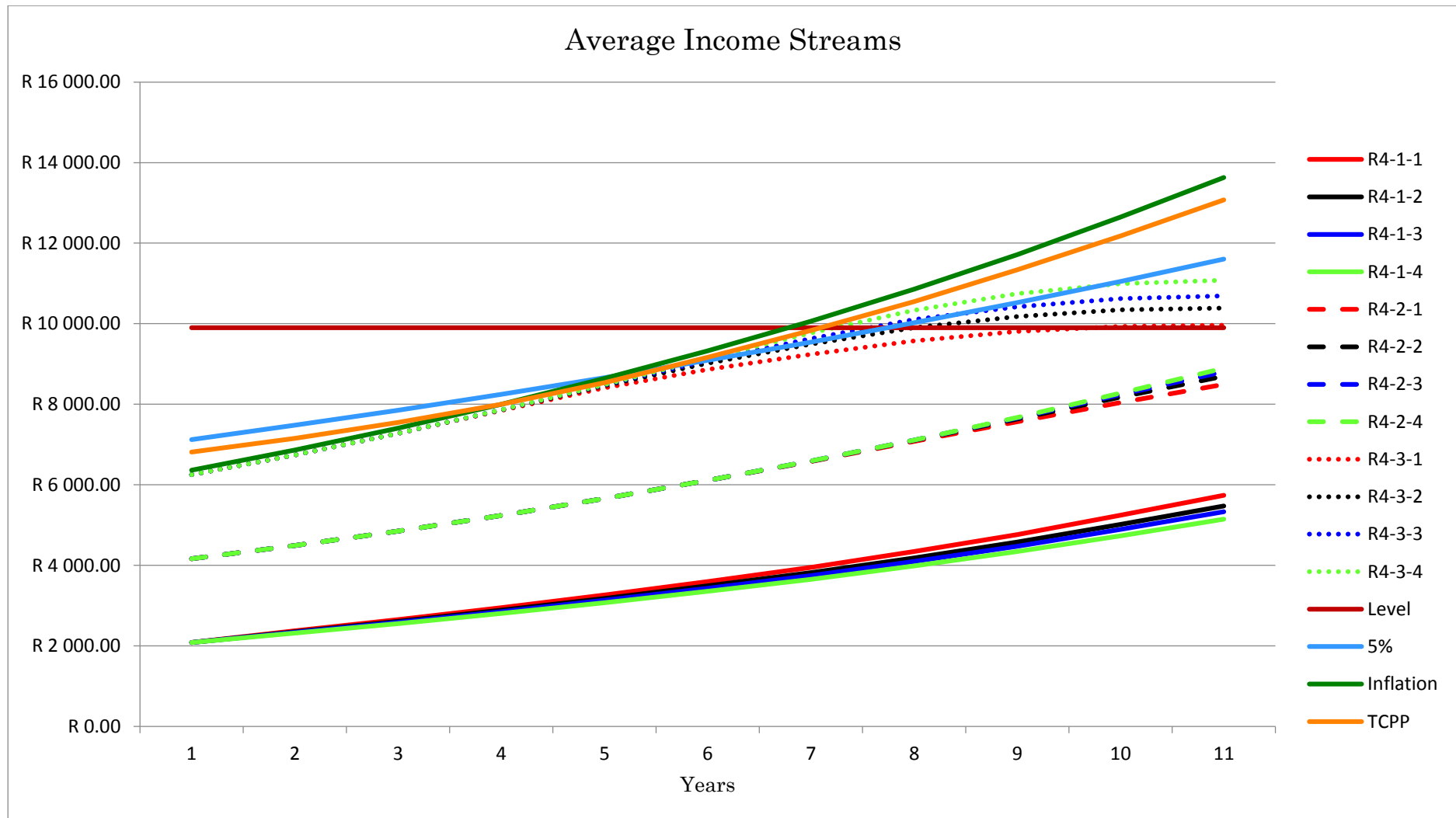


Figure 5.39: Average Income Streams

Source: Author (2015)

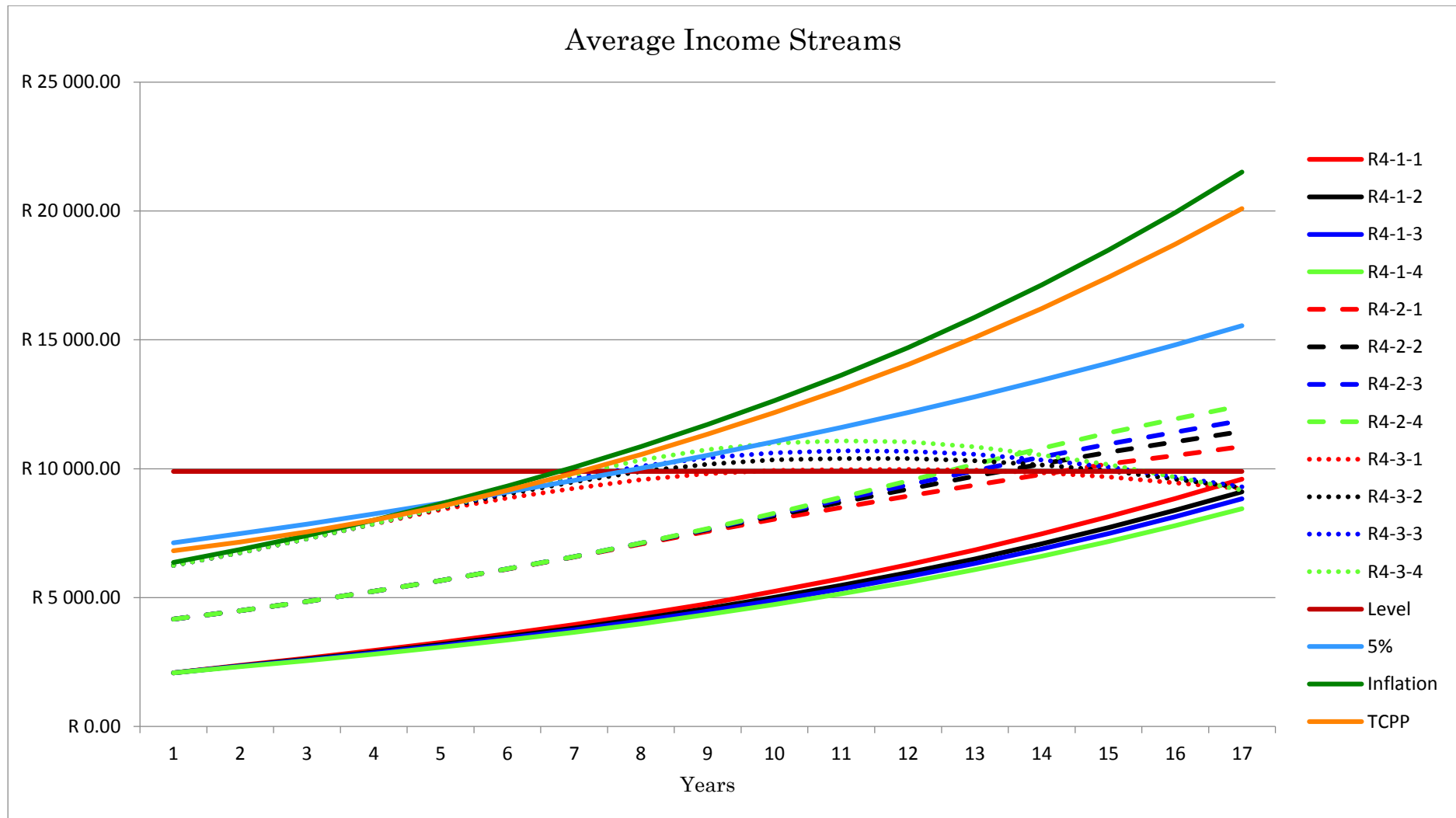


Figure 5.40: Average Income Streams (increased life expectancy)

Source: Author (2015)

5.4.8 Conclusion

In conclusion, if the 70 year-old male has a strong bequest motive together with the need of matching the income streams of guaranteed annuities he might consider the R4-3-4 strategy. This will provide a similar income stream to the 5% escalating annuity and has a final year ruin probability of 54%. With regards to the possibility of inheritance he can expect 32% of the total present value earned in terminal value form.

This strategy is, however, not sustainable for longer than the average life expectancy of eleven years and it is thus concluded that only retirees with lower life expectancies should consider this strategy. Alternatively one could opt for the level annuity as this provides the highest present value and the term of a non-increasing income stream is relatively short.

The TCPP and inflation-linked products may be considered if an increasing income stream is required. These strategies do not deliver the highest guaranteed present values under average life expectancies but are favoured when the retiree lives longer than expected.

5.5 Retiree Case 5

This section presents the results for a 55 year-old male with a life expectancy of 21 years. He also has a spouse, aged 52, who has a life expectancy of 28 years. It is important to note that from an income perspective the annuities would now need to sustain two people and not just one as was the situation in retiree cases 1 to 4.

As we will see in the income comparison the incomes from the guaranteed annuities decrease at the death of the male annuitant. This is because the annuities provide for a 75% spouse's pension, i.e. the income reduces by 25% after the death of the main member.

5.5.1 Present Values Analysis

From the present value analysis in Figures 5.41 and 5.42 one can see that the R5-1-1 living annuity strategy provides the highest average present value. The reason, as before, is that while the 7.5% initial drawdown strategies will provide a higher actual income over the life of the retirees, the 2.5% strategies allow the underlying portfolio to accumulate a higher terminal value, resulting in a higher subsequent present value.

It is interesting to note that the inflation-linked annuity has the highest average present value of all guaranteed annuities. This is an important difference in comparison to the previous retiree cases. This annuity, as well as the level annuity, are the only two that return present values higher than R1 000 000. One can, however, clearly see the upside potential of the TCPP annuity in Figure 5.41. It even gets close to matching the upside average present values from the R5-3-4 strategy (which has a final year ruin probability close to 100%) while doing so on a risk-free basis. It should be noted though that the annuity also has downside potential, but on average returns a present value which is only 4% below the R1 000 000 mark.

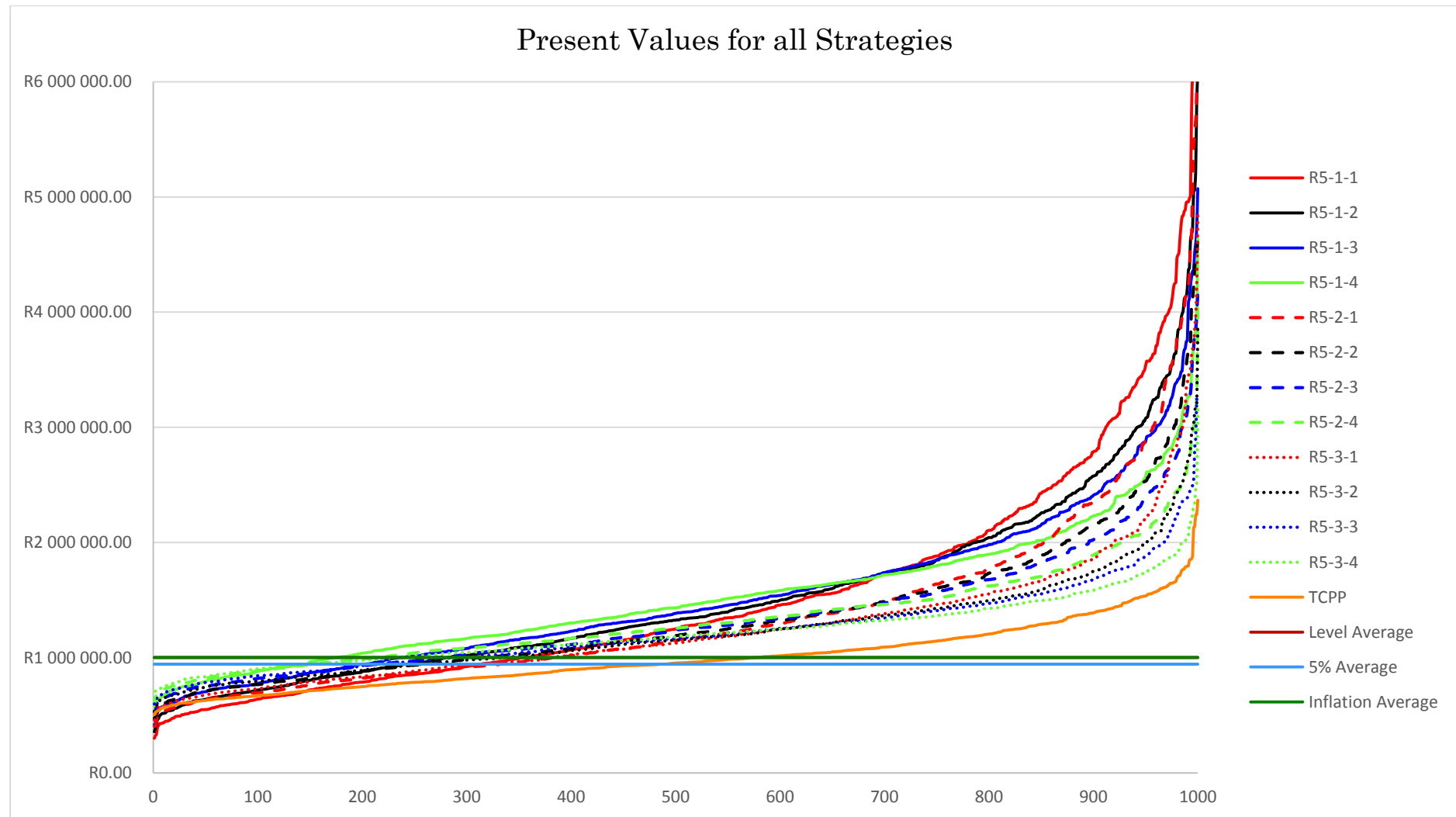


Figure 5.41: Present Values for all Strategies

Source: Author (2015)

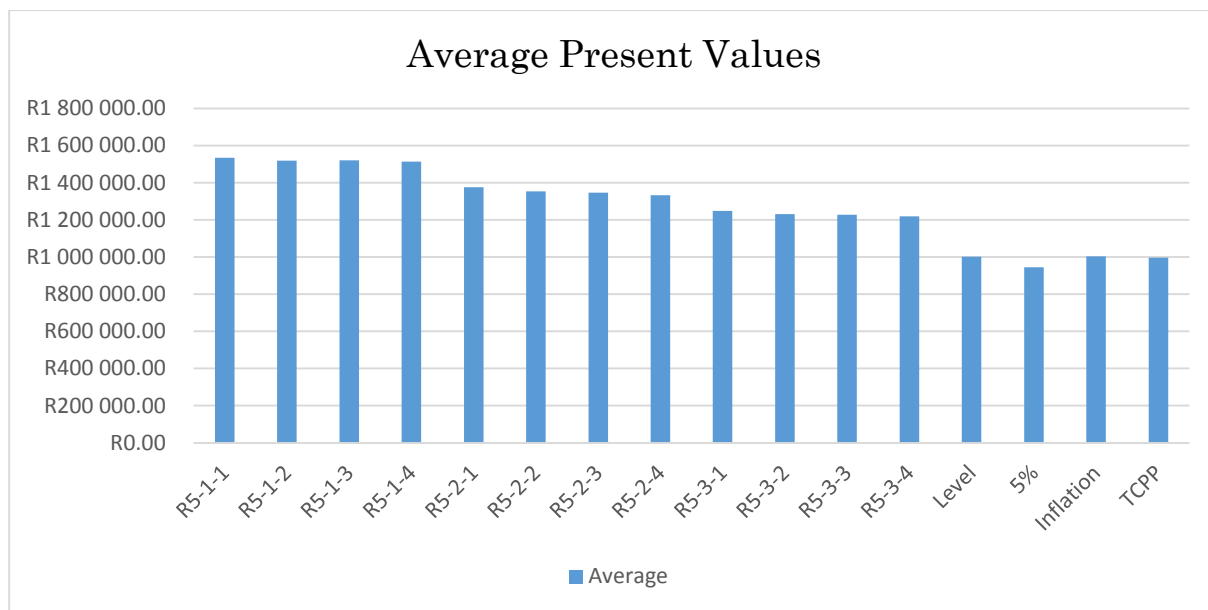


Figure 5.42: Average Present Values

Source: Author (2015)

Figure 5.43 depicts the result of increasing the life expectancy of both retirees by six years. The 5% escalating annuity now surpasses the level annuity in terms of average present values. The inflation-linked product seems to be the best performing guaranteed product and outperforms the R5-3-3 and R5-3-4 living annuity strategies. The TCPP annuity is the second best performing guaranteed product but fails to outperform any of the living annuity strategies.

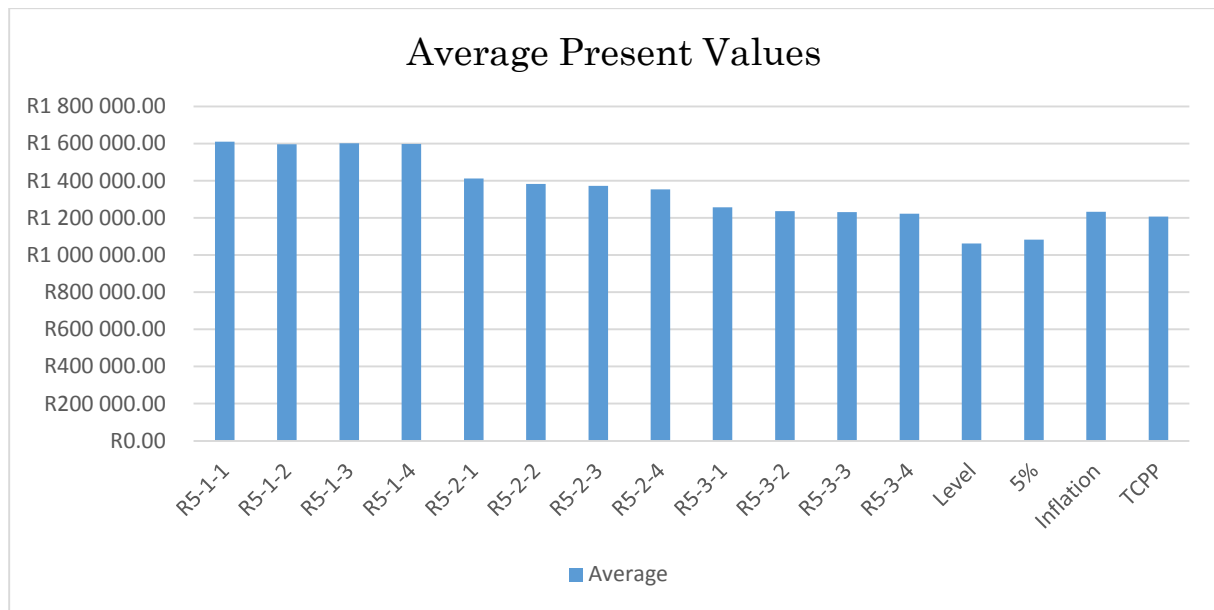


Figure 5.43: Average Present Values (increased life expectancy)

Source: Author (2015)

5.5.2 Percentile Analysis

Based on a percentile analysis one can see from Figure 5.44 that the R5-1-4 strategy is the optimal living annuity strategy. It has the lowest number of observations below the 20th percentile, equalling 12% and the highest number of observations between the 80th and 100th percentile equalling 42%. The R5-1-1 strategy has the highest number of living annuity observations below the 20th percentile, equalling 29%. It also underperforms the R5-1-4 strategy in all other percentiles.

The R1 000 000 mark is around the 35th percentile in this case. This provides support for the guaranteed annuities and seems to favour the level annuity if upside potential is taken into account. The inflation-linked annuity provides relative safety around the R1 000 000 mark. The TCPP annuity outperforms all living annuity strategies in the 20th to 40th percentile range.

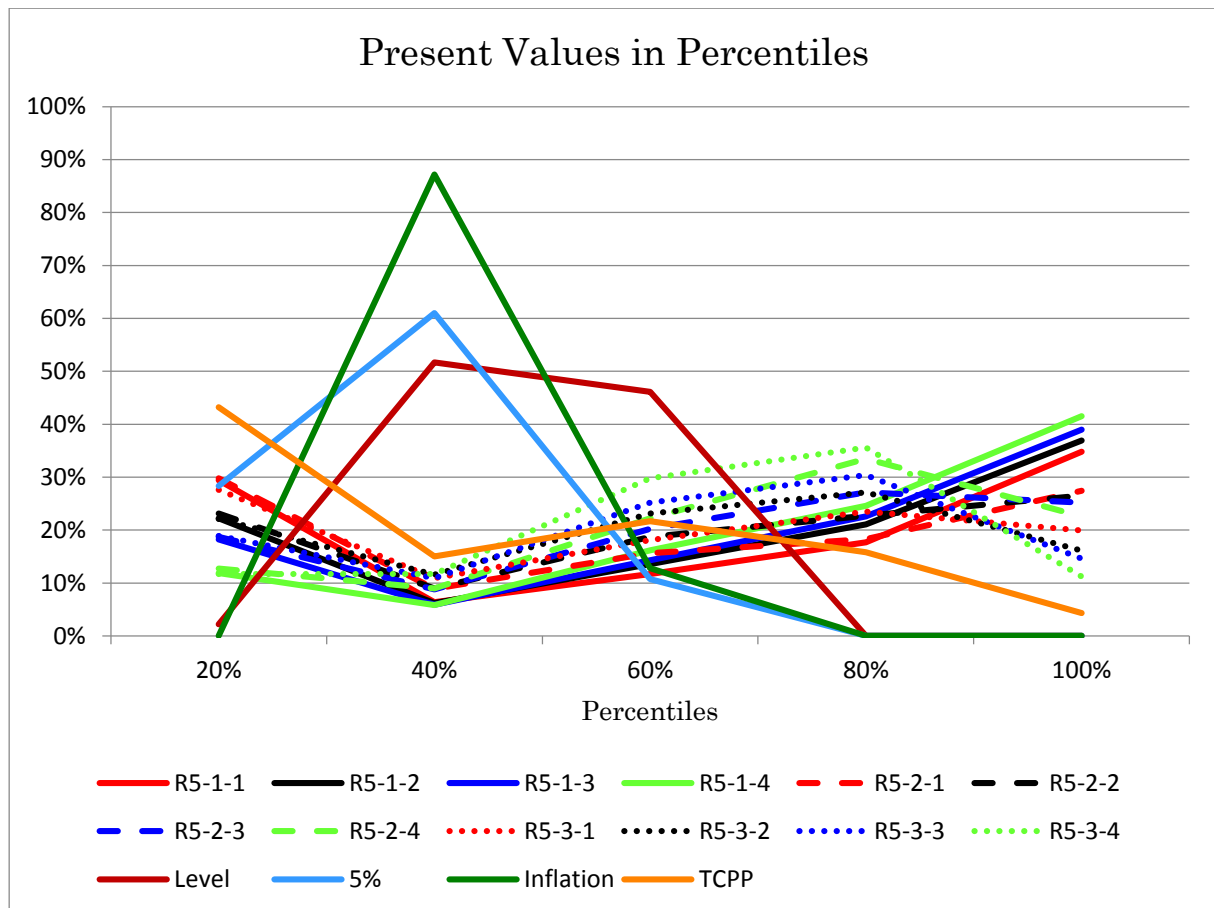


Figure 5.44: Present Values in Percentiles

Source: Author (2015)

5.5.3 Financial Ruin Analysis

The outperformance of the 2.5% initial drawdown strategies is supported by the financial ruin analysis. Figure 5.45 presents these results. The 7.5% initial drawdown strategies have a ruin percentage above 60% as soon as the 12th year after retirement and have a ruin probability of almost 100% at the expected death of the female annuitant. The 5% initial drawdown strategies do not present significantly better results as the aggressive portfolio has a ruin probability of 73% at the expected death of the spouse. The R5-1-1 to R5-1-4 strategies are therefore the best performers and specifically the conservative portfolio has a ruin probability of only 5% at the expected death of the spouse. The question then is whether or not it can provide a sufficient income stream that will at least match that of the guaranteed annuities.

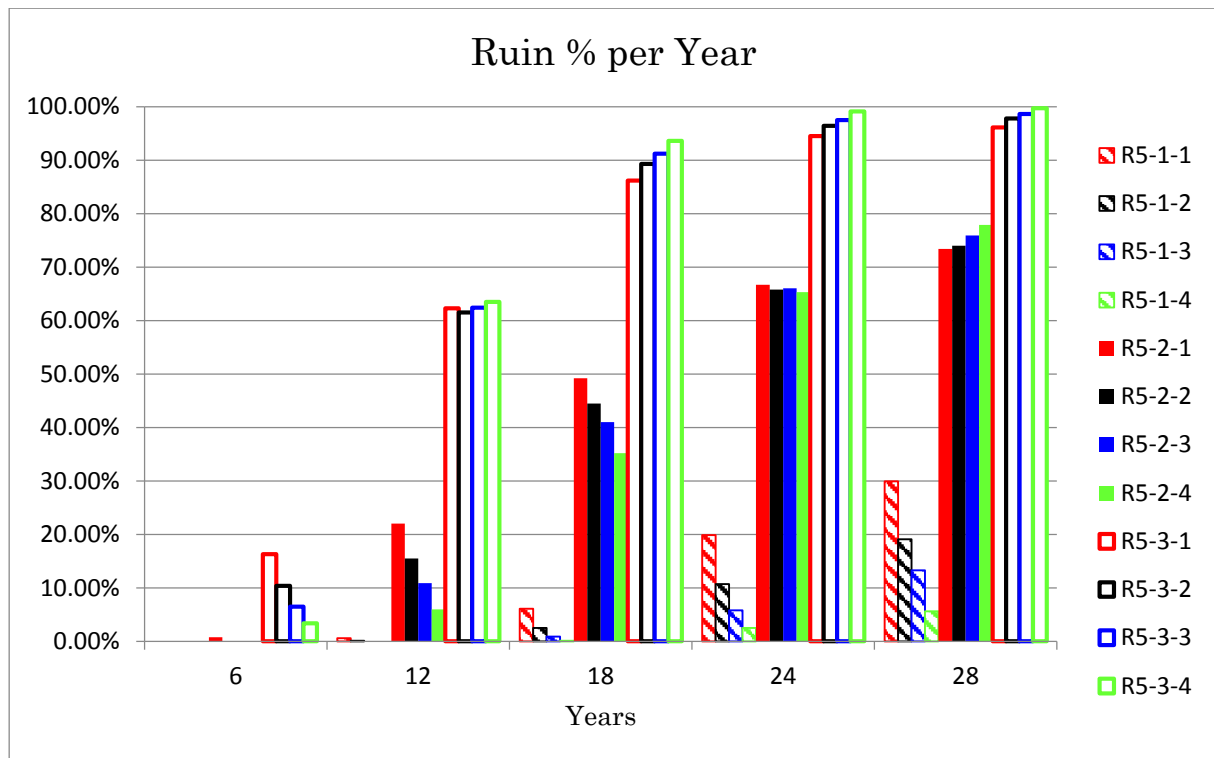


Figure 5.45: Ruin % per Year

Source: Author (2015)

5.5.4 Annuity-to-Terminal Value Analysis

The annuity-to-terminal value percentages are presented in Figure 5.46 as a further outperformance indication of the R5-1-1 to R5-1-4 strategies. From this one can conclude that the present values of the 7.5% initial drawdown strategies almost completely consist of annuity income. The underlying fund is therefore depleted and this echoes the high ruin probabilities indicated in Figure 5.45. The 5% initial drawdown strategies have slightly higher terminal value percentages, reaching a maximum of 13% for the aggressive portfolio.

The various asset allocation strategies in the case of the 2.5% initial drawdown strategy return between 32% and 43% of the total present value in terminal value form. This strategy is the only strategy that provides a meaningful monetary amount to the beneficiaries.

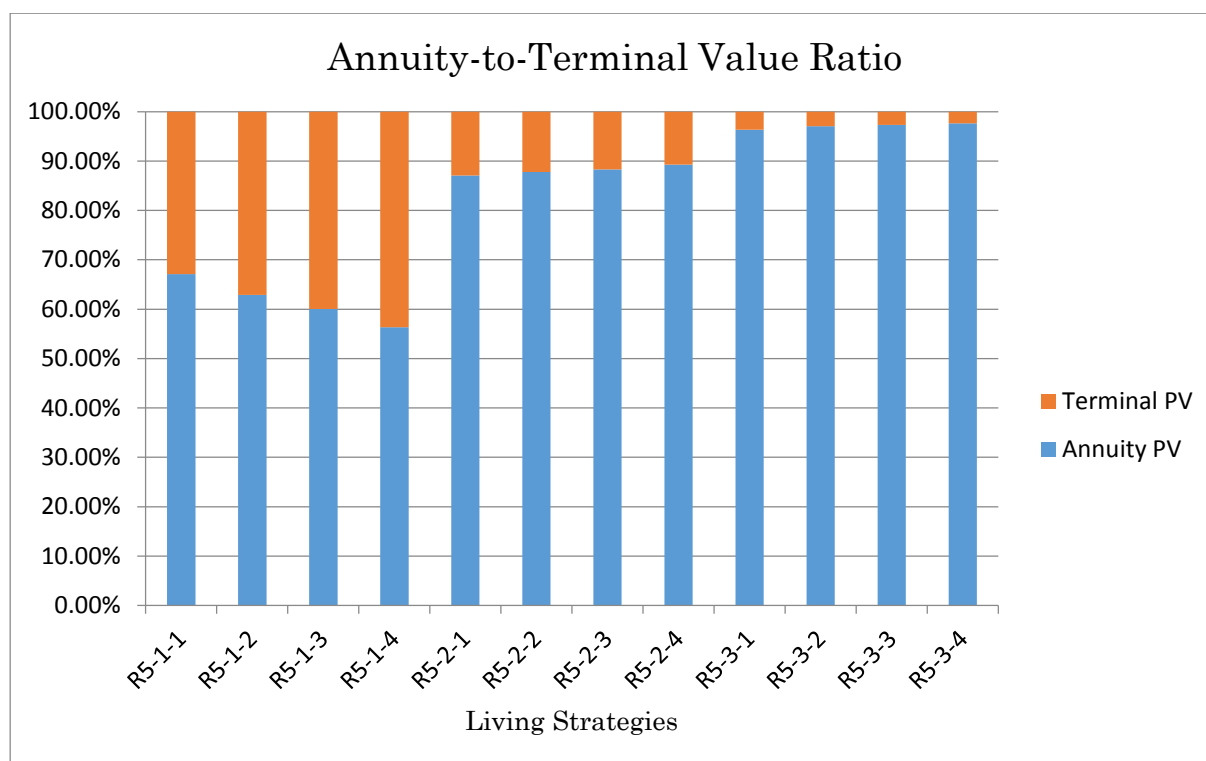


Figure 5.46: Annuity-to-Terminal Value Ratio

Source: Author (2015)

5.5.5 Probability of Outperforming Guaranteed Annuities

The probability of living annuities outperforming guaranteed annuities, on average, is presented in Figure 5.47. From this it is clear that the present values of the living annuities are much higher than the average values returned by the guaranteed annuities. As before, the living annuity strategies have the highest probability of outperforming the 5% escalating annuity, equal to 85% for conservative portfolios regardless of the initial drawdown strategy.

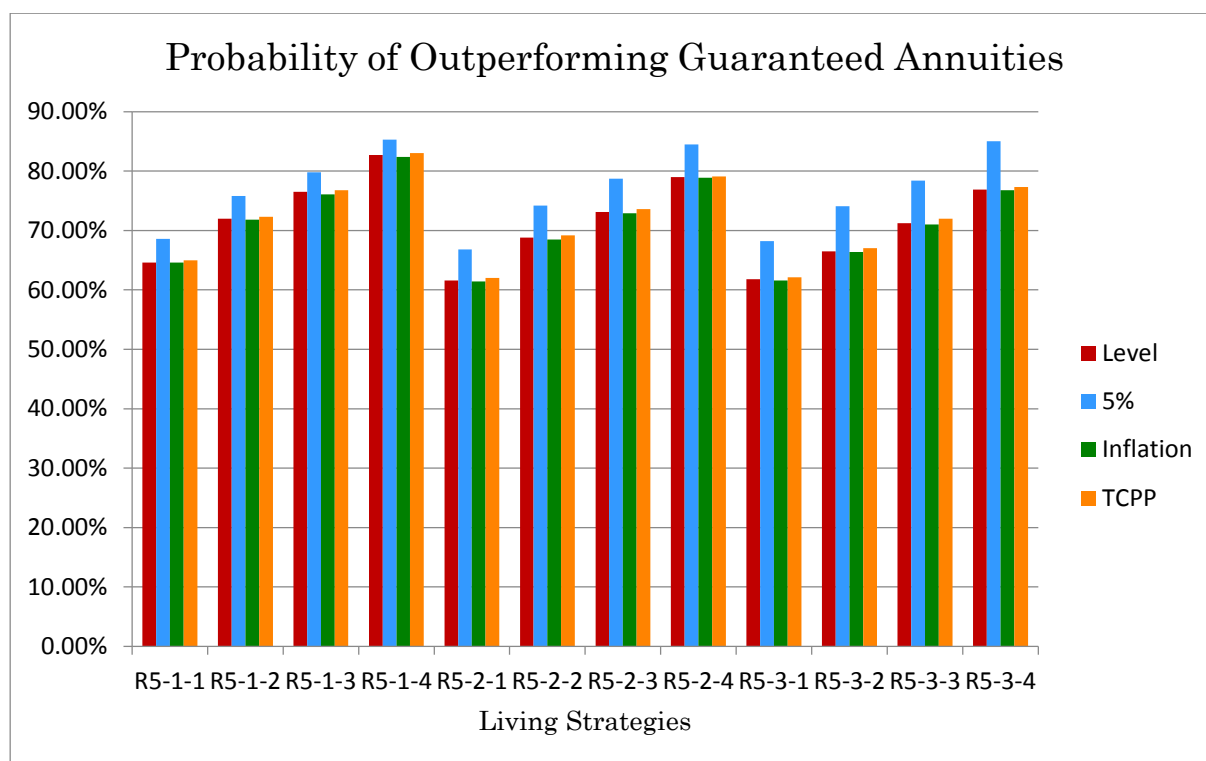


Figure 5.47: Probability of Outperforming Guaranteed Annuities

Source: Author (2015)

5.5.6 Annuity Replacement Model

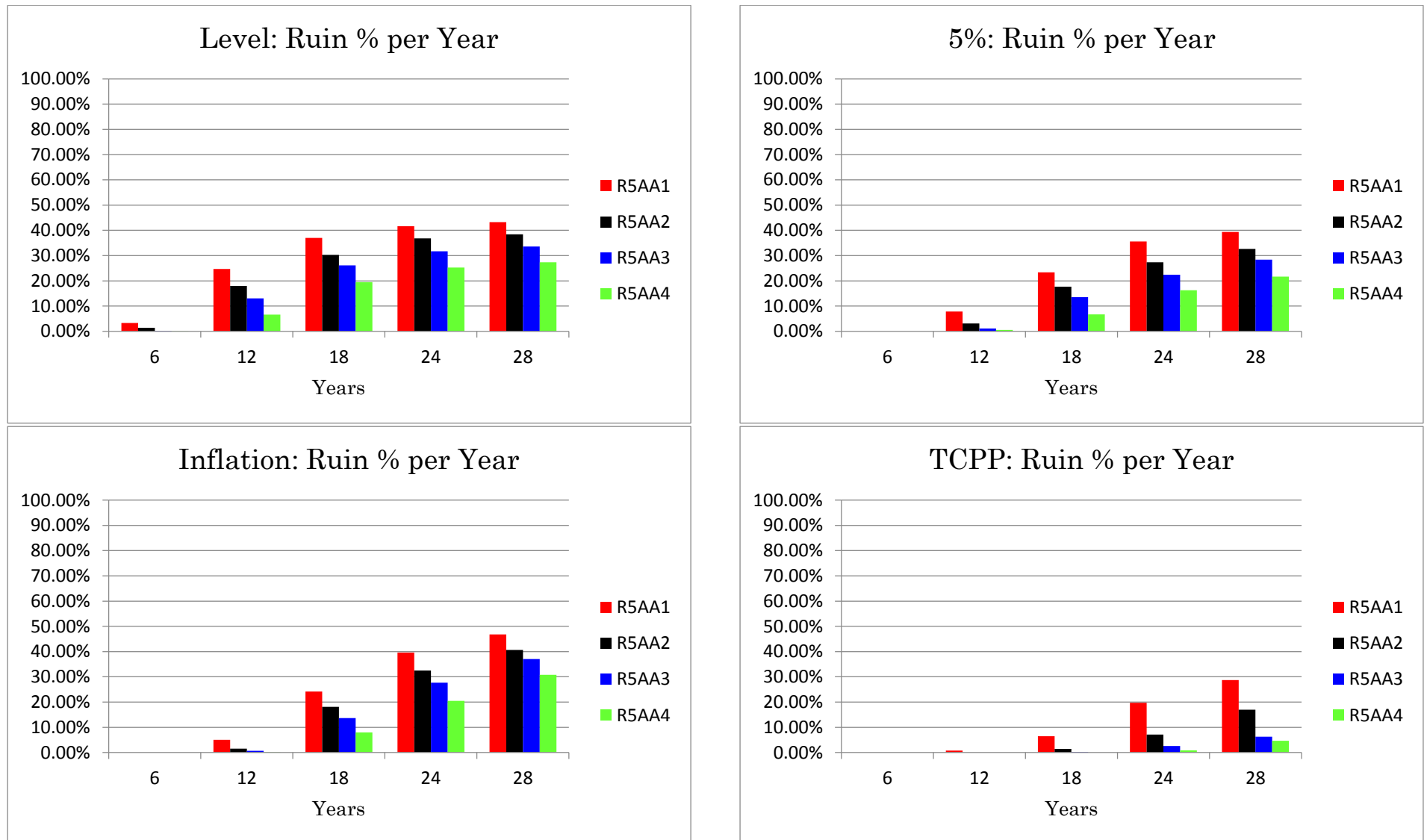
Next, the Annuity Replacement Model is presented to compare living and guaranteed annuities. Figure 5.48 presents these results. From this it is clear that, firstly, the ruin probabilities are lower than in retiree cases 1 to 4. This is due to the lower incomes that the guaranteed annuities now provide. Table 5.2 is presented to show the differences in initial annuities between retiree cases 1 and 5. For example, the 55 year-old single life male receives an initial level annuity that is 8.5% higher than the joint-life option.

Table 5.2: Initial Annuity Differences

Annuity	Difference
Level	8.5%
5%	15.9%
Inflation	19.3%
TCP	18.4%

Source: Author (2015)

Secondly, the underlying annuity portfolio has the best chance of simulating the annuities paid by the TCP annuity as this portfolio has a final year ruin probability of 28% for the aggressive portfolio and 5% for the conservative portfolio. The final year ruin probabilities for the other annuities are similar, ranging between 39% and 47% for aggressive portfolios, depending on the product simulated. This is an indication that the living annuitant would be able to obtain the same level of income as the guaranteed annuities at a relatively low risk. It should be noted, however, that the reason the final year ruin probability of the TCP is lower than the other annuities is due to the fact that the income paid by this product is based on market returns. Thus, in poor performing markets the increase in annuity will be lower than in rallying markets.

**Figure 5.48: Ruin % per Year**

Source: Author (2015)

5.5.7 Income Stream Comparison

As a final comparison the monthly income streams from the annuities are compared. Figure 5.49 presents these results. If one ignores the R5-2-1 to R5-2-4 and R5-3-1 to R5-3-4 strategies, based on the ruin analysis, one can focus only on the R5-1-1 to R5-1-4 strategies in the comparison with guaranteed annuity income streams.

When compared to the level annuity one sees these strategies surpass the level annuity around year 14, the 5% escalating annuity around year 18, and the TCPP and inflation-linked annuity only after the expected death of the main member. It is important to remember that the income streams now have to provide for the financial needs of two people. If one deems the R5-1-1 strategy as a viable solution, the retirees would need to accept a monthly income stream that is approximately R1 000 less than the TCPP annuity or the inflation-linked product for 21 years. Only the spouse that survives the male annuitant benefits from this larger income stream.

It is important to note that the inflation-linked, level, and TCPP annuities provide similar present values. Thus it would be better to opt for either the TCPP or inflation-linked products as these have a guaranteed increasing income stream.

A mortality shock of six years for both individuals is again introduced to the model and the income stream results are presented in Figure 5.50. No significant changes in the results are obtained. This is due to the low ruin probability of the 2.5% initial drawdown strategy and the fact that it can sustain an increasing income stream. On an average present value analysis the longer investment horizon should favour guaranteed annuities. The longer guaranteed annuitants manage to live, the more they benefit from the mortality pooling effect.

**Figure 5.49: Average Income Streams**

Source: Author (2015)

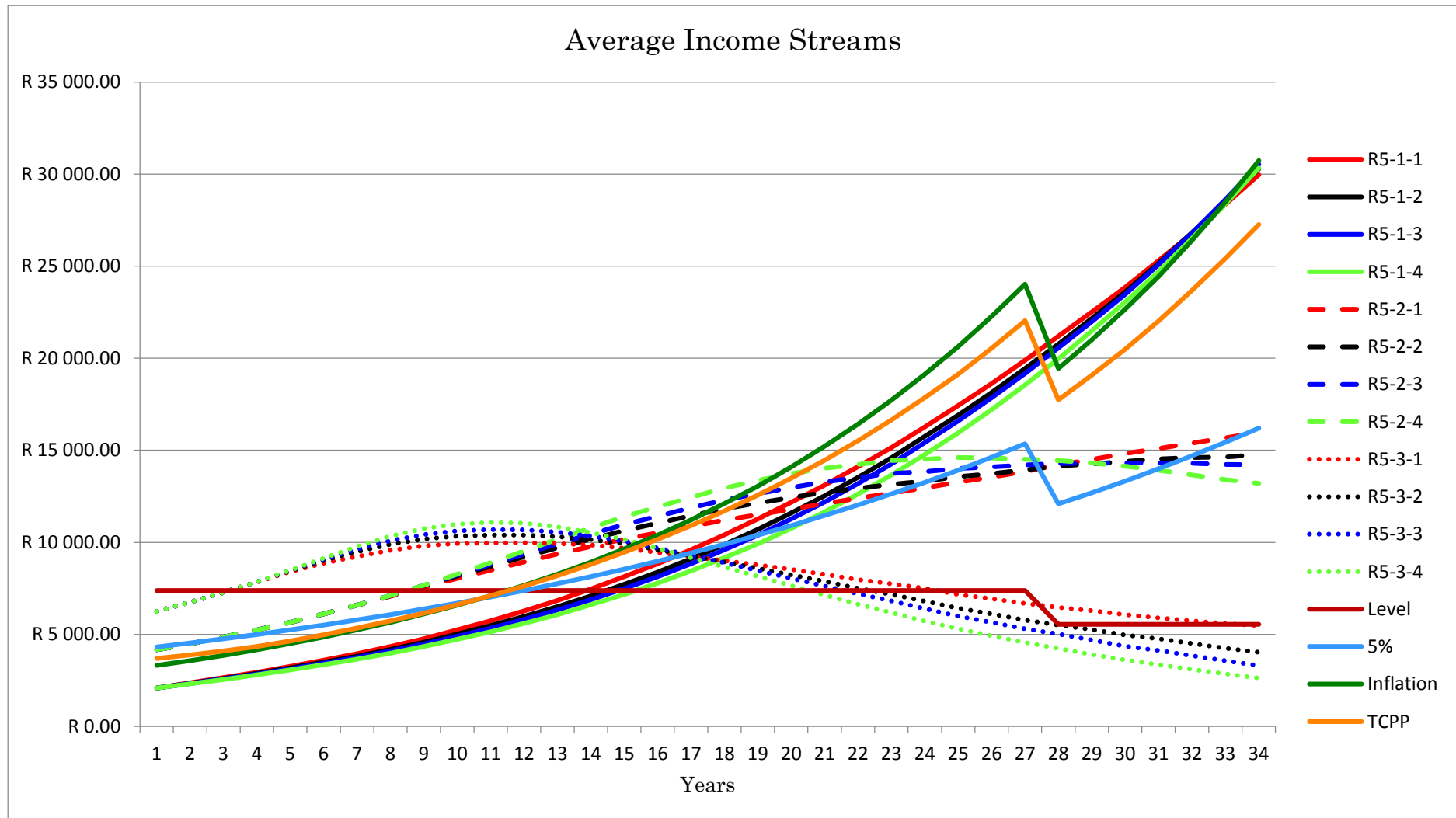


Figure 5.50: Average Income Streams (increased life expectancy)

Source: Author (2015)

5.5.8 Conclusion

In conclusion, based on a pure present value analysis the R5-1-1 strategy delivers the highest present value. However, the R5-1-4 strategy outperforms all other living annuity strategies on a percentile, ruin, and annuity-to-terminal value ratio analysis. Thus, if the retirees are content with receiving a lower income relative to the TCPP and inflation-linked annuity in retirement, they can follow the R5-1-4 strategy which will have a final year ruin probability of 5.6%. Furthermore, 43.7% of the total present value received will be in the form of the terminal value of the fund at the death of the female annuitant.

From a guaranteed annuity perspective it is difficult to choose between the TCPP, inflation-linked and level annuity. Based on a percentile analysis the level annuity offers more upside potential, but it is argued that for such a long life expectancy, the longest in this study, one should rather opt for an increasing income stream product. If this is of importance to the annuitants they should opt for either the inflation-linked or TCPP annuity.

5.6 Retiree Case 6

This section discusses the results for a 60 year-old male retiree with a life expectancy of 18 years who has a spouse, aged 57, with a life expectancy of 24 years.

5.6.1 Present Values Analysis

Figures 5.51 and 5.52 depict the present values for all strategies. Living annuity performance remains the same as before. The R6-1-1 strategy outperforms the other strategies on a pure present value analysis. From a guaranteed annuity perspective, there is a clearer distinction compared with retiree case 5. The level annuity now outperforms the other guaranteed annuities based on average values. It is important to note that none of the four guaranteed products returns a present value greater than R1 000 000, although the TCPP annuity does provide upside potential.

A six year increase in the life expectancy of the retirees favours the inflation-linked and TCPP annuities. Figure 5.53 shows that both these products now have present values which are similar to the lowest living annuity strategy (R6-3-4).

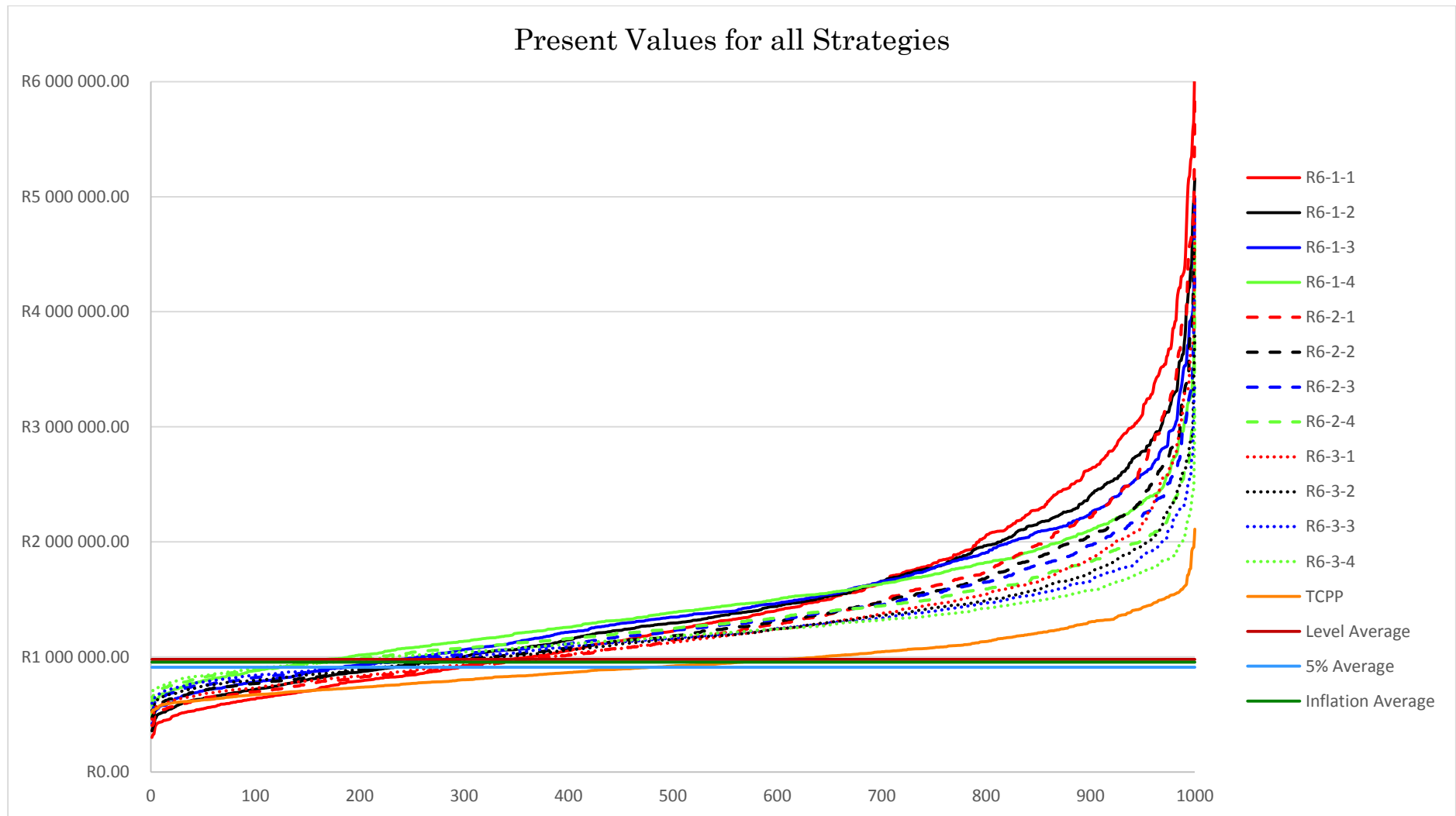
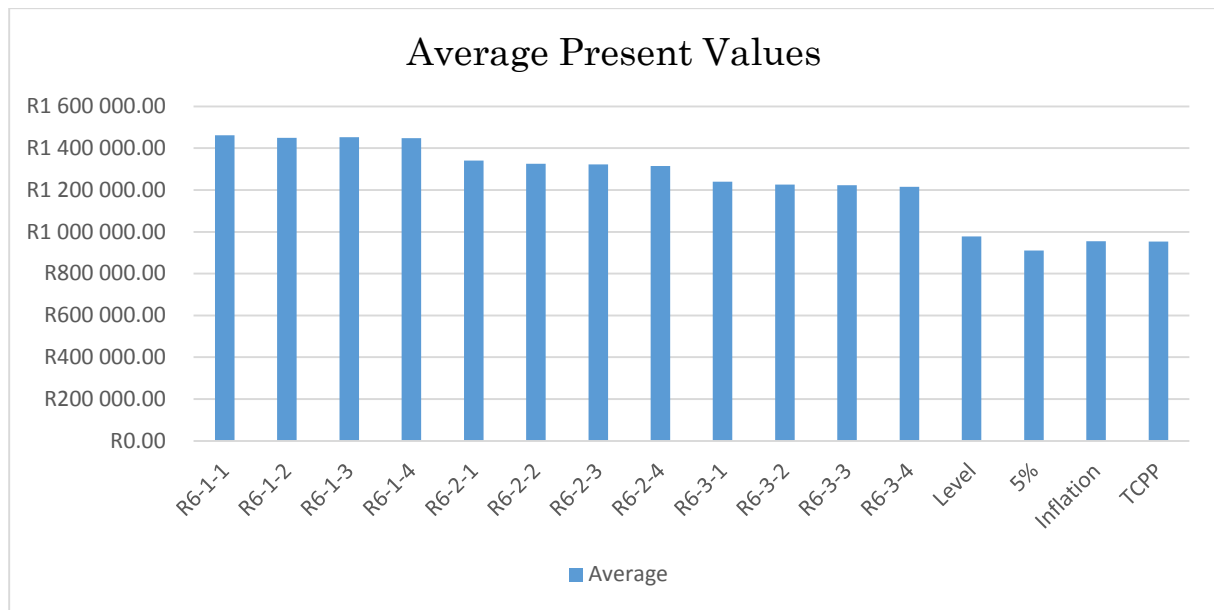
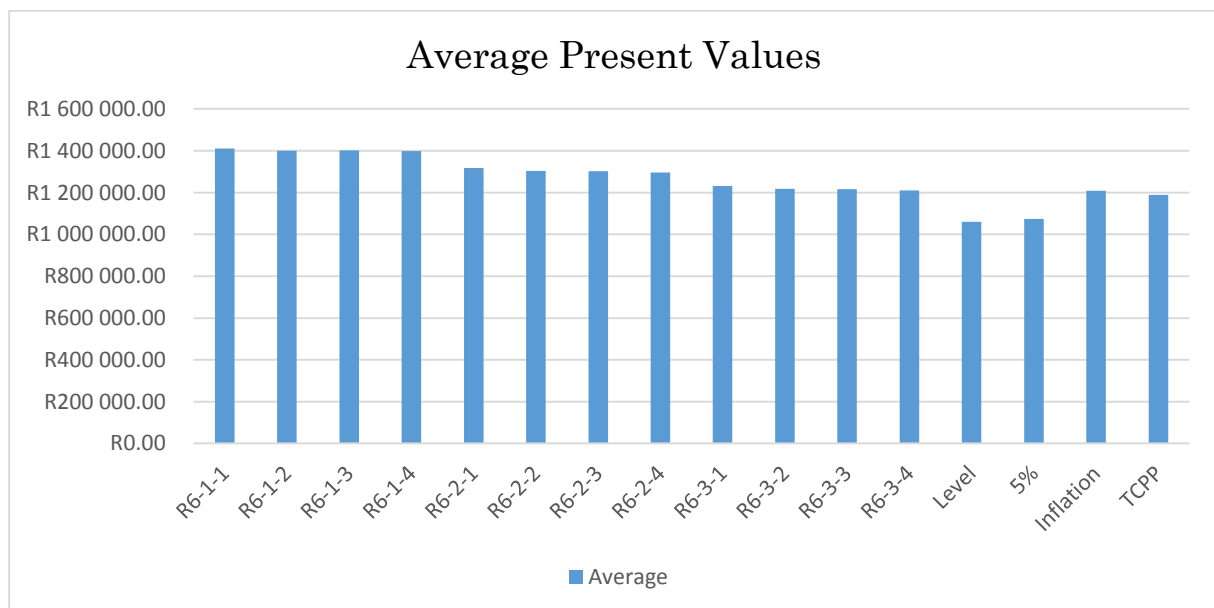


Figure 5.51: Present Values for all Strategies

Source: Author (2015)

**Figure 5.52: Average Present Values**

Source: Author (2015)

**Figure 5.53: Average Present Values (increased life expectancy)**

Source: Author (2015)

5.6.2 Percentile Analysis

Based on Figure 5.54, which presents the percentile analysis, one can conclude that the 5% escalating annuity is falling further out of favour in comparison with retiree case 5 due to the fact that it has more observations below the 20th percentile. The R1 000 000 mark lies around the 43rd percentile and one would thus wish to see strategies having a high number of observations from the 60% percentile mark and upwards.

From the figure one can conclude that the level annuity performs best among the guaranteed annuities in the sense that it has the most observations in the 40th to 60th percentile range. A total of 48% of its present values lies within this range compared to 23% of the TCPP's present values.

The R6-1-4 strategy again performs best from a living annuity perspective as it has 10% of all observations below the 20th percentile and 38% of all observations between the 80th and 100th percentile. Although there are strategies that have more observations in the mid percentiles they either have too many observations below the 20th percentile or too few between the 80th and 100th percentile.

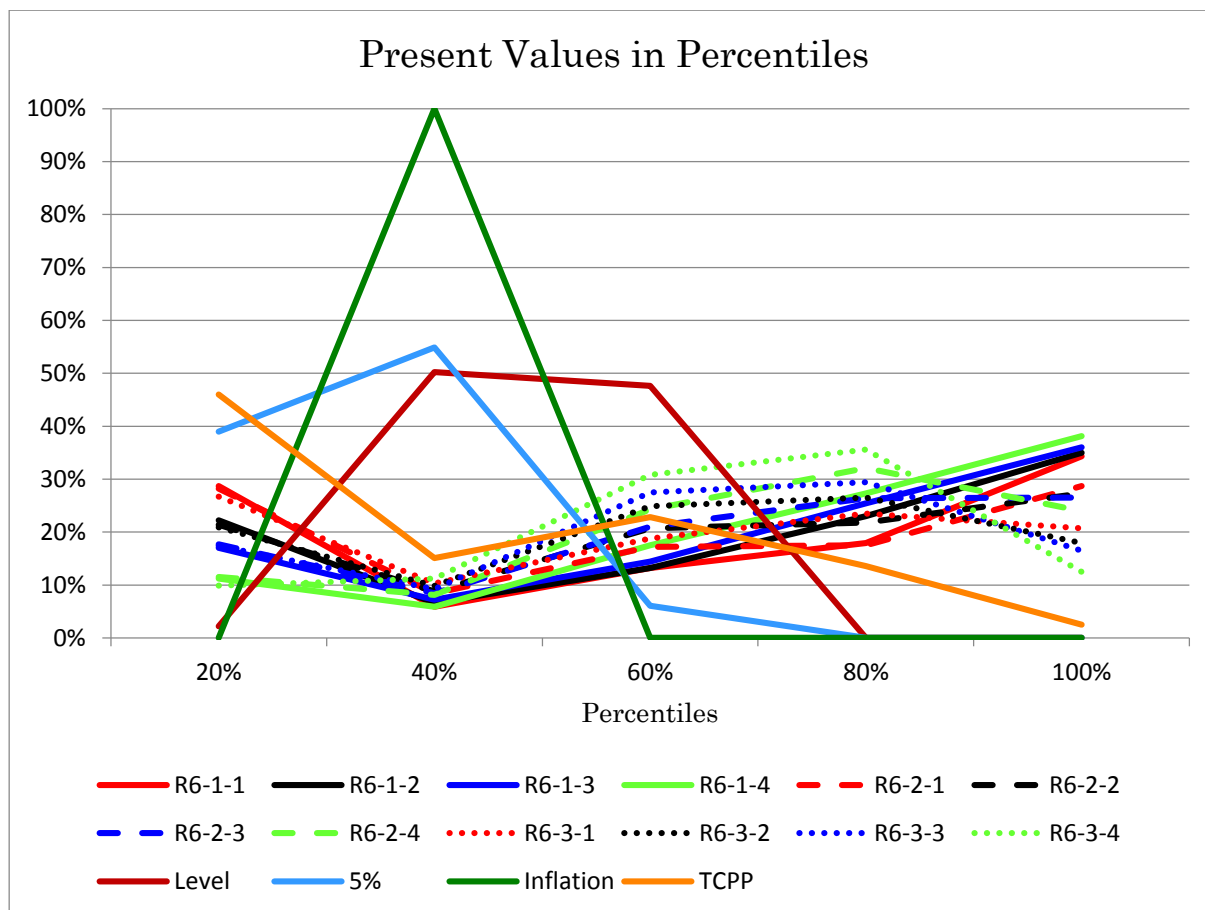


Figure 5.54: Present Values in Percentiles

Source: Author (2015)

5.6.3 Ruin Analysis

The ruin percentages are presented in Figure 5.55 to further assist in selecting the optimal living annuity strategy. From this it is clear that the R6-1-1 to R6-1-4 strategies are the only ones that can be deemed to be financially sustainable. The R6-1-1 strategy has a final year ruin probability of 20%, the R6-1-2 strategy a probability of 11%, the R6-1-3 strategy a probability of 6%, and the R6-1-4 strategy a probability of 2.5%. The 5% and 7.5% initial drawdown strategies have final year ruin probabilities greater than 65% regardless of asset allocation.

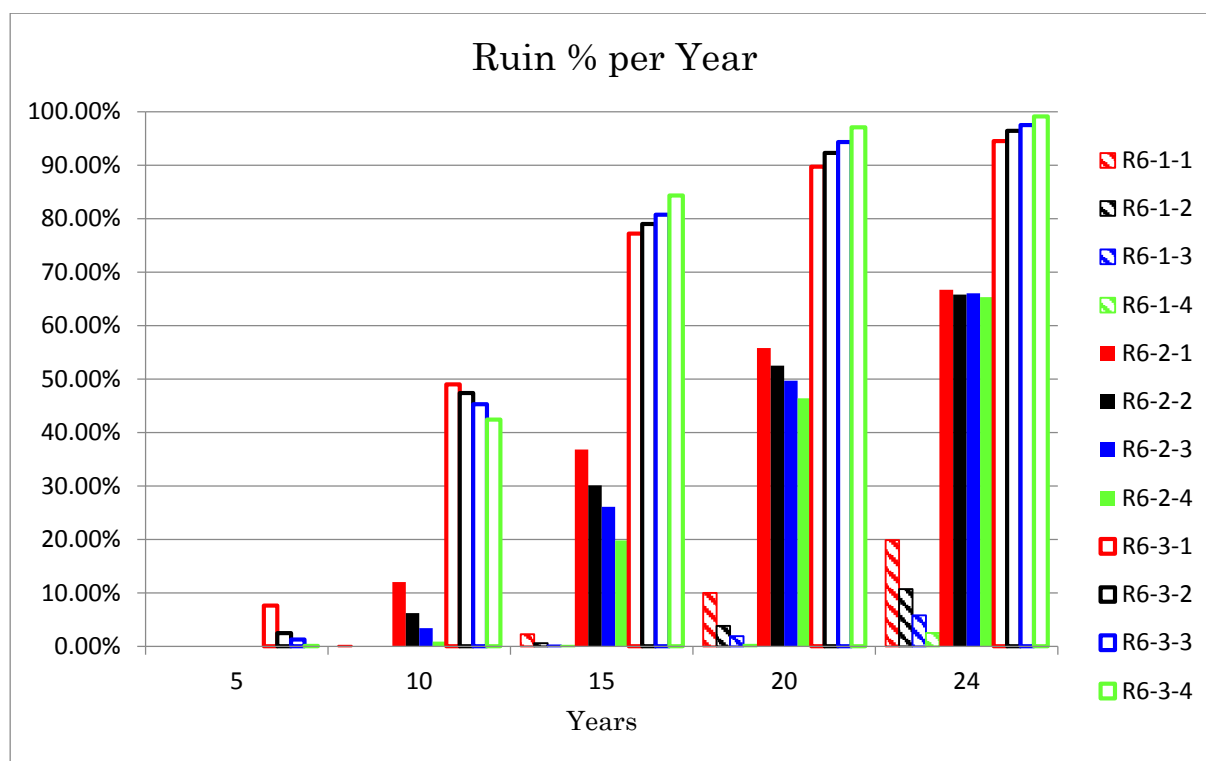


Figure 5.55: Ruin % per Year

Source: Author (2015)

5.6.4 Annuity-to-Terminal Value Analysis

As an additional living annuity analysis one can consider the annuity-to-terminal value ratio which is presented in Figure 5.56. The same results and conclusions as were made for retiree case 5 can be made for this 60 year-old and his spouse. The majority of present values for the 7.5% initial drawdown strategies consists of annuity income. The 5% initial drawdown strategies perform somewhat better providing about 17% of total present value in terminal value form.

The R6-1-1 to R6-1-4 strategies deliver 40%, 44%, 47%, and 50% of total present values in terminal value form, respectively. The remainder is attributable to annuity income. One would conclude that these strategies are the only viable options when considering the bequest motive.

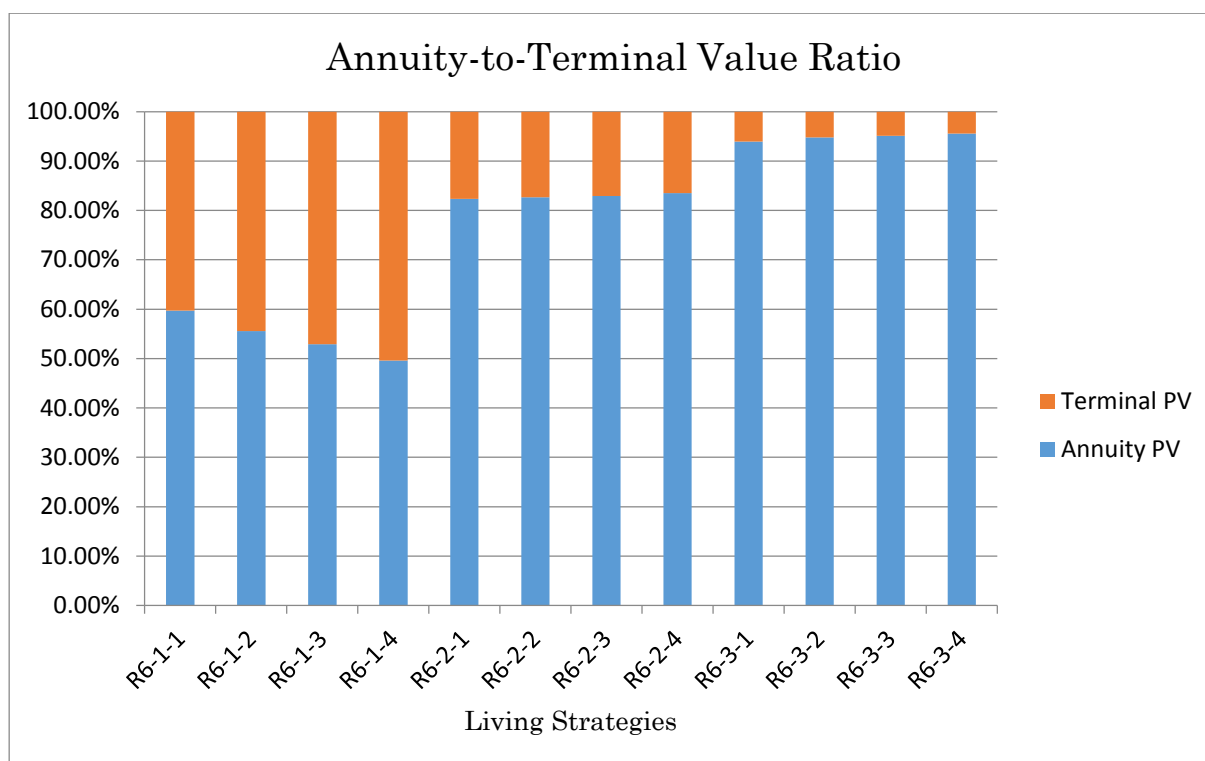


Figure 5.56: Annuity-to-Terminal Value Ratio

Source: Author (2015)

5.6.5 Probability of Outperforming Guaranteed Annuities

This section presents the probability of living annuities outperforming the average present values of guaranteed annuities. The results are presented in Figure 5.57.

No significant difference between this retiree case and the previous ones could be found. Each of the living annuity strategies still has a high probability of outperforming each of the guaranteed annuities. The minimum probabilities that a living annuity strategy will outperform the guaranteed level, 5% escalating, inflation-linked and TCPP annuities are equal to 63%, 70%, 65% and 65%, respectively.

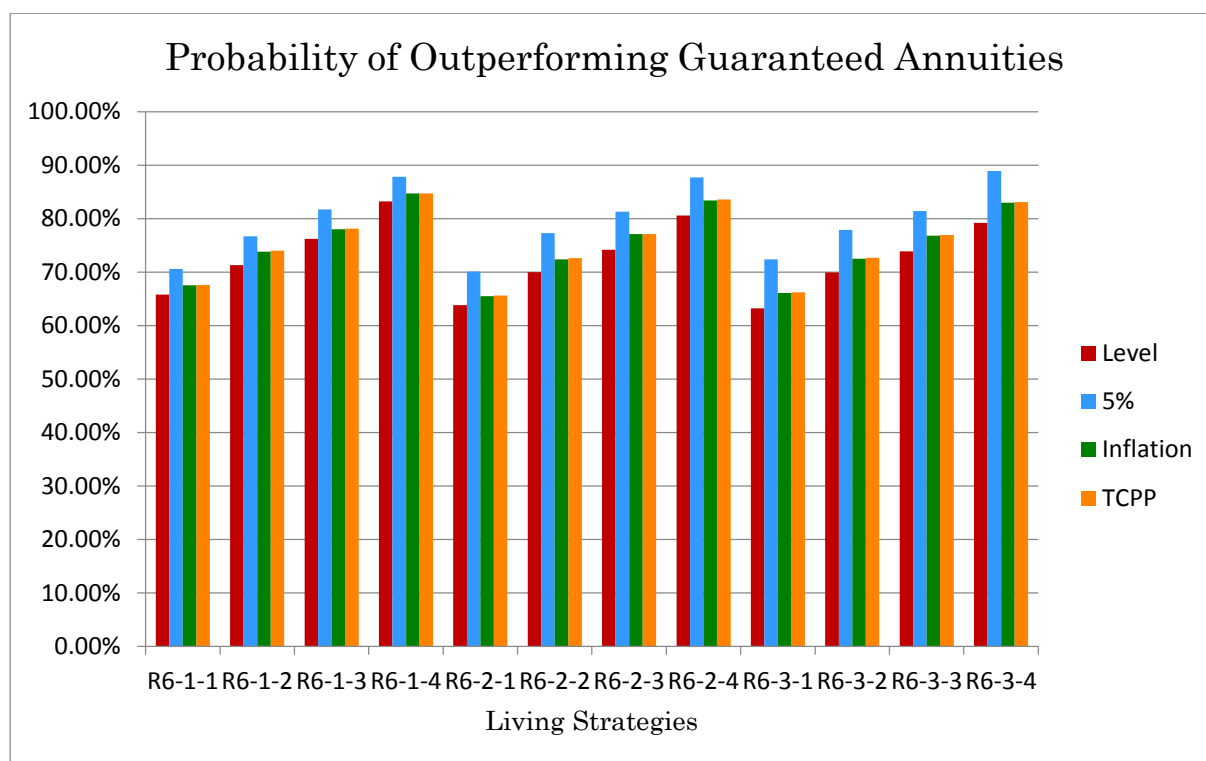


Figure 5.57: Probability of Outperforming Guaranteed Annuities

Source: Author (2015)

5.6.6 Annuity Replacement Model

The results of the ARM are presented in Figure 5.58. Compared with the previous case study this figure suggests that the older retirees are, the more likely living annuity portfolios will be able to sustain the income streams generated by these annuities. The level annuity still has a relatively high ruin percentage in year ten, which is due to its higher initial annuity. This is equal to 21% for the aggressive portfolio and 5% for the conservative portfolio.

At the time of the spouse's death the level and inflation-linked portfolios had the highest ruin probabilities ranging from 27% for conservative portfolios to 45% for aggressive portfolios. The income structure of the TCPP annuity was, again, most successful and had a maximum final year ruin probability of 29% for the aggressive portfolio.

These results suggest that a retiring couple could simulate a guaranteed income structure in a living annuity portfolio by assuming a maximum risk of final year ruin of 45%.

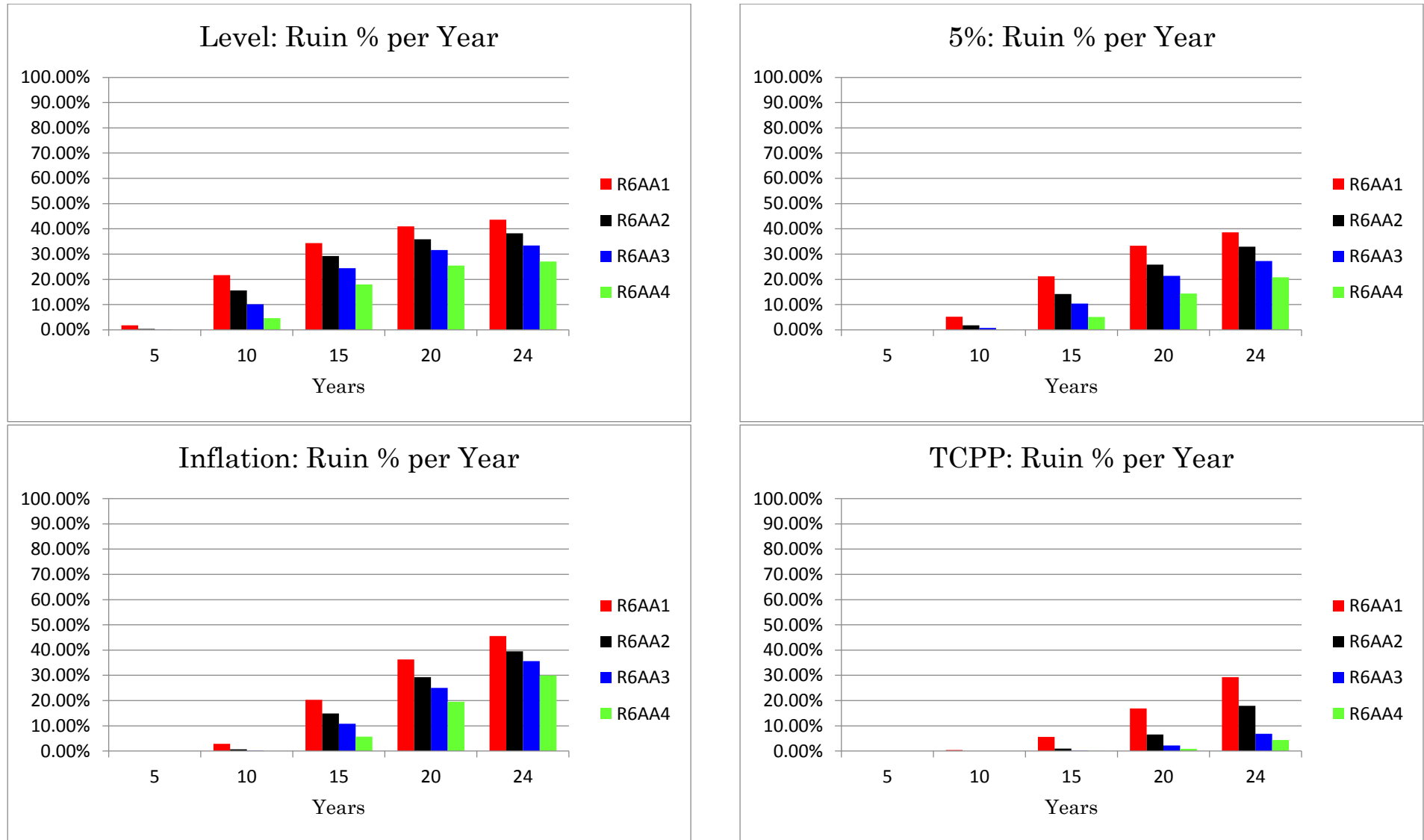


Figure 5.58: Ruin % per Year

Source: Author (2015)

5.6.7 Income Stream Comparison

Figures 5.59 and 5.60 are presented as a final comparison of the different types of annuities. One can conclude from Figure 5.59 that the R6-2-1 to R6-2-4 strategies all show a promising monthly income stream. They outperform the guaranteed annuities, except the level annuity, between years six and fourteen, and then again after year eighteen.

However, the 5% initial drawdown strategies provide this income stream at a final year ruin probability of around 65% and returns only 18% of the total present value in terminal value form. This can be contrasted with the ARM results which stated that one could simulate a guaranteed income structure in a living annuity portfolio by taking on a maximum risk of final year ruin of 45%. The TCPP and inflation-linked annuities seem to provide the best income streams, although the level annuity does have a higher present value.

The aggressive 2.5% initial drawdown strategy, in contrast, provides its income stream at a final year ruin probability of 20% and returns 40% of the total present value in terminal value form. The conservative strategy has a final year ruin probability of only 2.5% and returns 50% of the total present value in terminal value form.

When an increase in the life expectancy is considered one can conclude that the R6-2-1 to R6-2-4 strategies fall out of favour as the income streams reduce and the ruin probabilities increase for this investment horizon. The 2.5% initial drawdown strategies match the TCPP and inflation-linked income streams, but only after the death of the male annuitant.



Figure 5.59: Average Income Streams

Source: Author (2015)

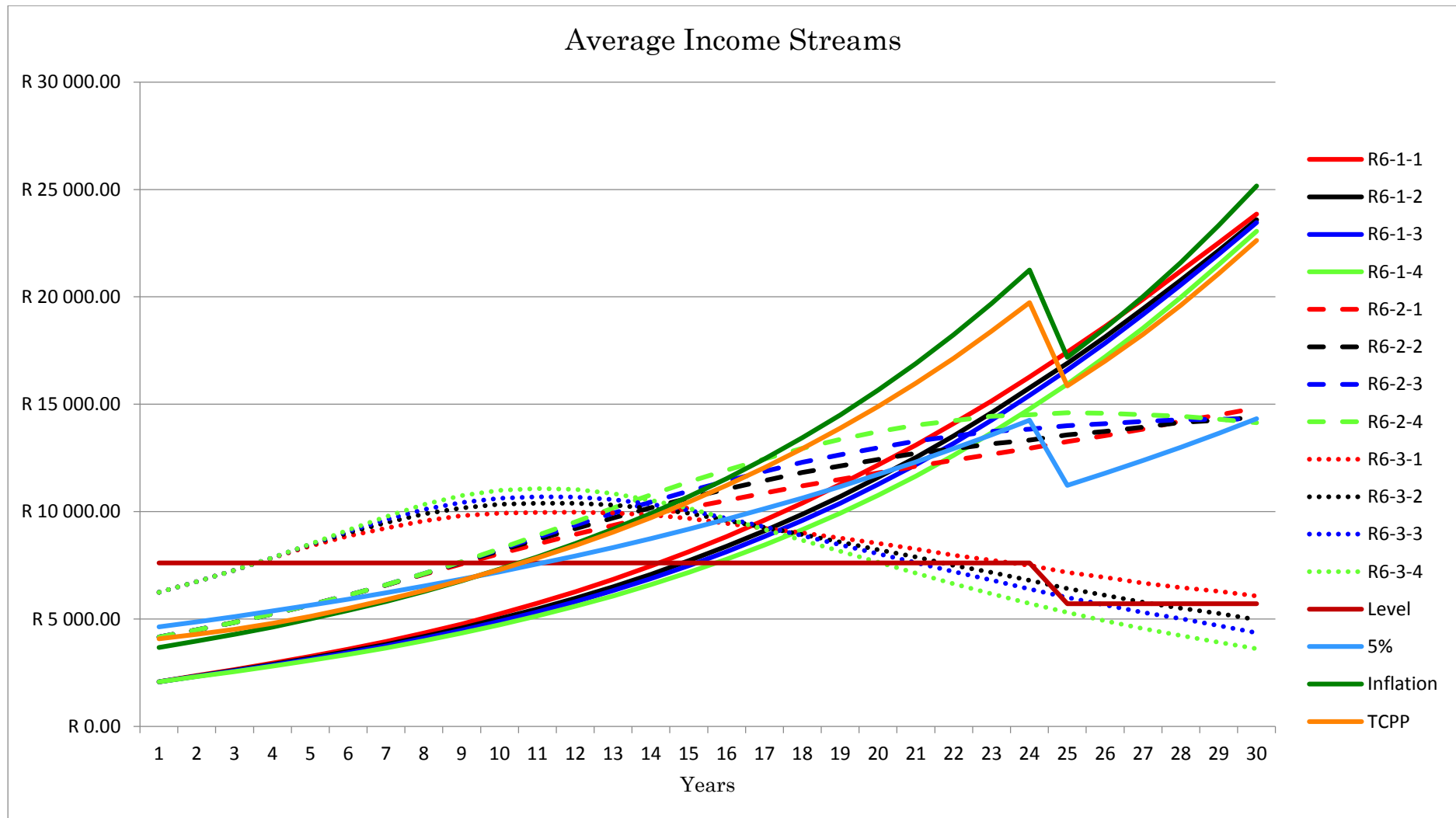


Figure 5.60: Average Income Streams (increased life expectancy)

Source: Author (2015)

5.6.8 Conclusion

In comparison with guaranteed annuities one can conclude that the living annuity strategies might have higher present values, but the risk of financial ruin is significant in the case of most living annuity strategies. In addition, the income streams of the R6-1-1 to R6-1-4 strategies are significantly lower than the TCPP and inflation-linked annuities. The level annuity might be competitive on a present value analysis but it seems too risky to receive a non-increasing income in retirement for 24 years.

Thus, it would appear that the only reason that a male retiree, aged 60 with a 57 year-old spouse, would invest in a living annuity is in order to leave an inheritance for their beneficiaries as 50% of the total R6-1-4 present value is returned in terminal value form. This comes at a final year ruin probability of 2.5%.

5.7 Retiree Case 7

This section presents the results for a 65 year-old male retiree with a life expectancy of 14 years and who has a spouse, aged 62 with a life expectancy of 20 years.

5.7.1 Present Values Analysis

Based on a present value analysis, Figures 5.61 and 5.62 show that the living annuities all have present values higher than the guaranteed annuities. The guaranteed annuities fail to return average present values higher than R1 000 000. Table 5.3 is presented to show how much lower the present values were relative to the initial R1 000 000 investment.

Table 5.3: Guaranteed Discount

Annuity	Discount
Level	6.6%
5%	16.84%
Inflation	12.8%
TCPP	12.5%

Source: Author (2015)

As usual the R7-1-1 strategy performs best in terms of the present value analysis. Whether or not this is a sustainable option is analysed in subsequent sections. What is also clear from Figure 5.61 is that the TCPP annuity is losing its ability to provide such a high upside potential, relative to the living annuities, when compared to retiree case 5.

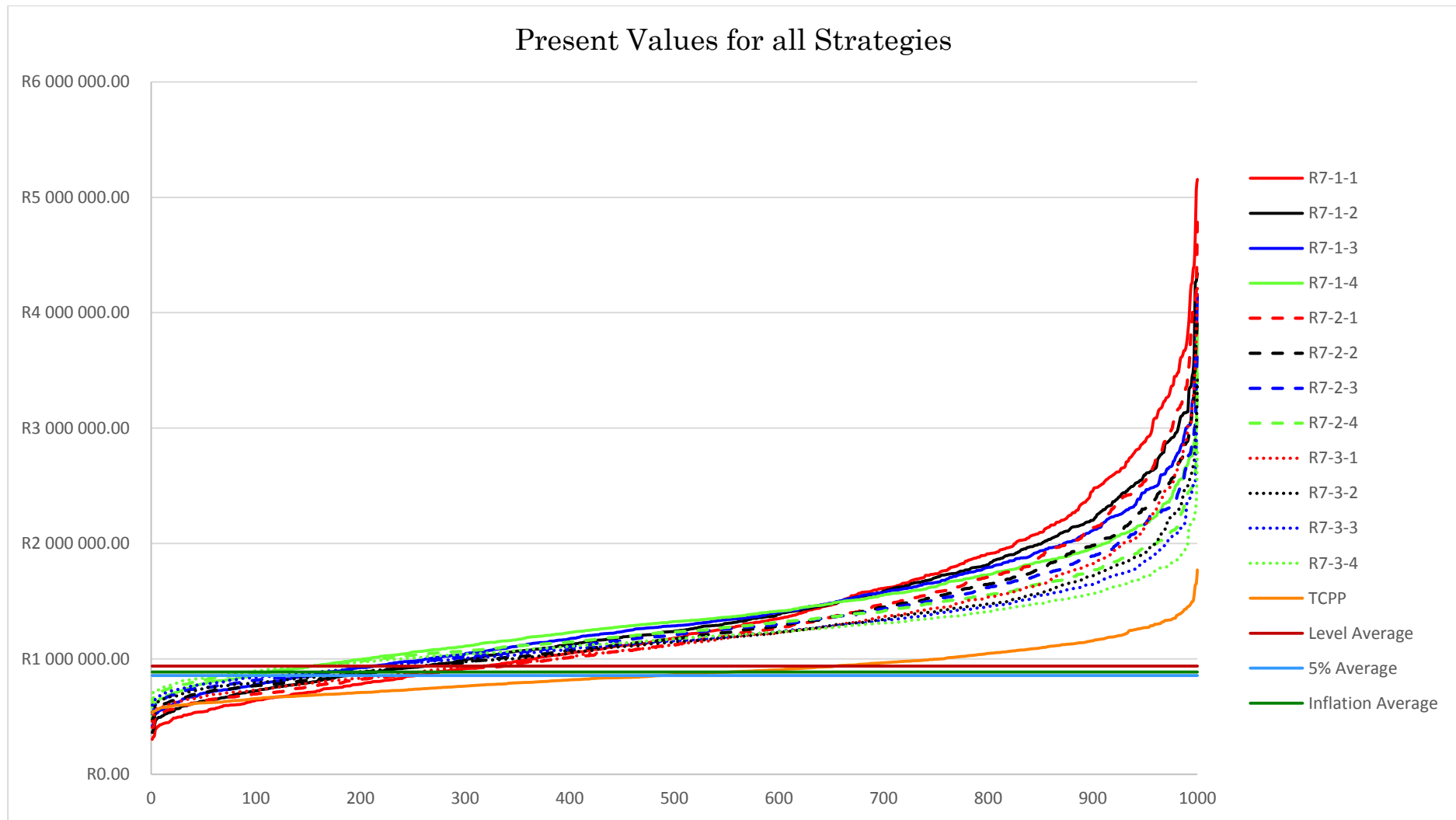


Figure 5.61: Present Values for all Strategies

Source: Author (2015)

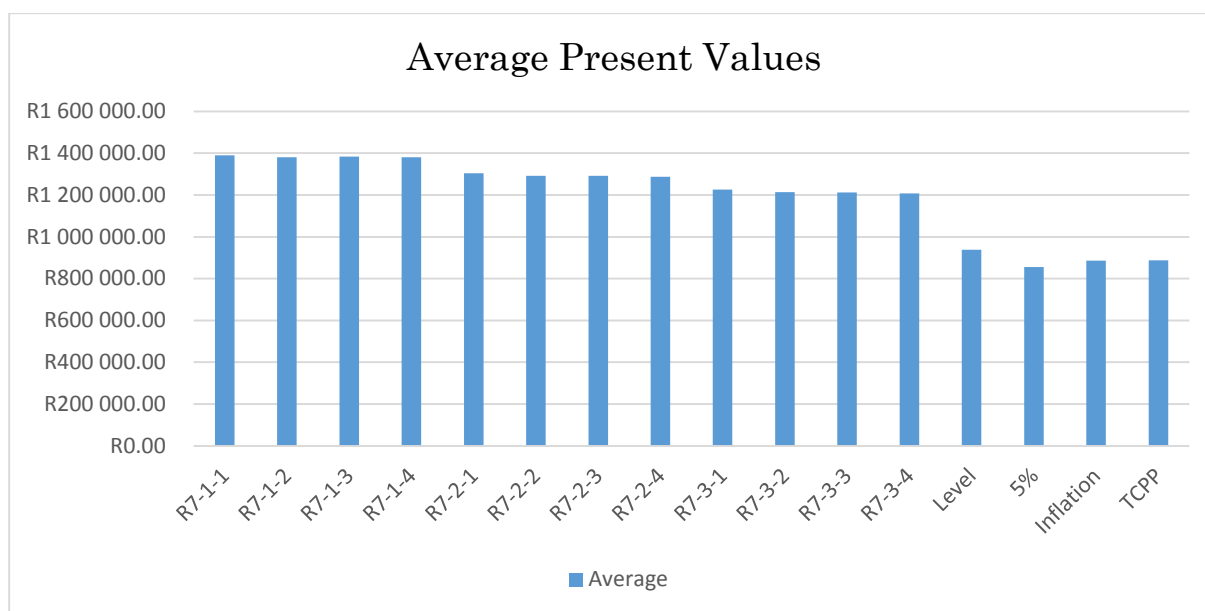


Figure 5.62: Average Present Values

Source: Author (2015)

When a six year increase in life expectancy is assumed one can again see the higher present value of the 5% escalating, inflation-linked, and TCPP annuity relative to the level annuity. However, none of these annuities provide higher average present values than the living annuity strategies. The lowest average living annuity present value is still around 4% higher than the highest guaranteed annuity present value.

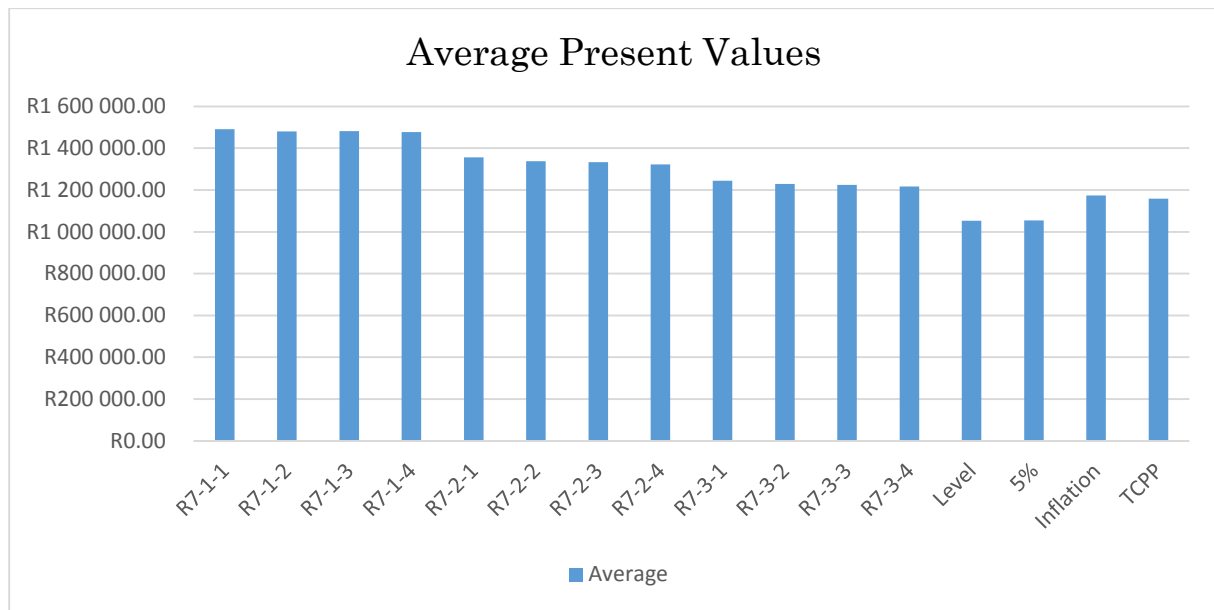


Figure 5.63: Average Present Values (increased life expectancy)

Source: Author (2015)

5.7.2 Percentile Analysis

From a percentile analysis one can see the underperformance of the 5% escalating annuity as it has the most observations of all annuities below the 20th percentile. What makes this performance even worse is that the R1 000 000 mark is close to the 46th percentile. The level annuity therefore seems to be the optimal annuity, at least from a guaranteed annuity perspective. A total of 32% of its present values are located in the 40th to 60th percentile range. The TCPP annuity has 23% of all its observations in this range.

From a living annuity perspective one can conclude that the R7-1-4, R7-2-4 and R7-3-4 strategies all exhibit promising percentile structures. Approximately 10% of their total observations are below the 20th percentile. The R7-3-4 strategy performs best in the midrange percentiles, and the R7-1-4 strategy best in the 80th to 100th percentile range. 35% of its observations lie in this range compared to 25% of the present values of the R7-2-4 strategy.

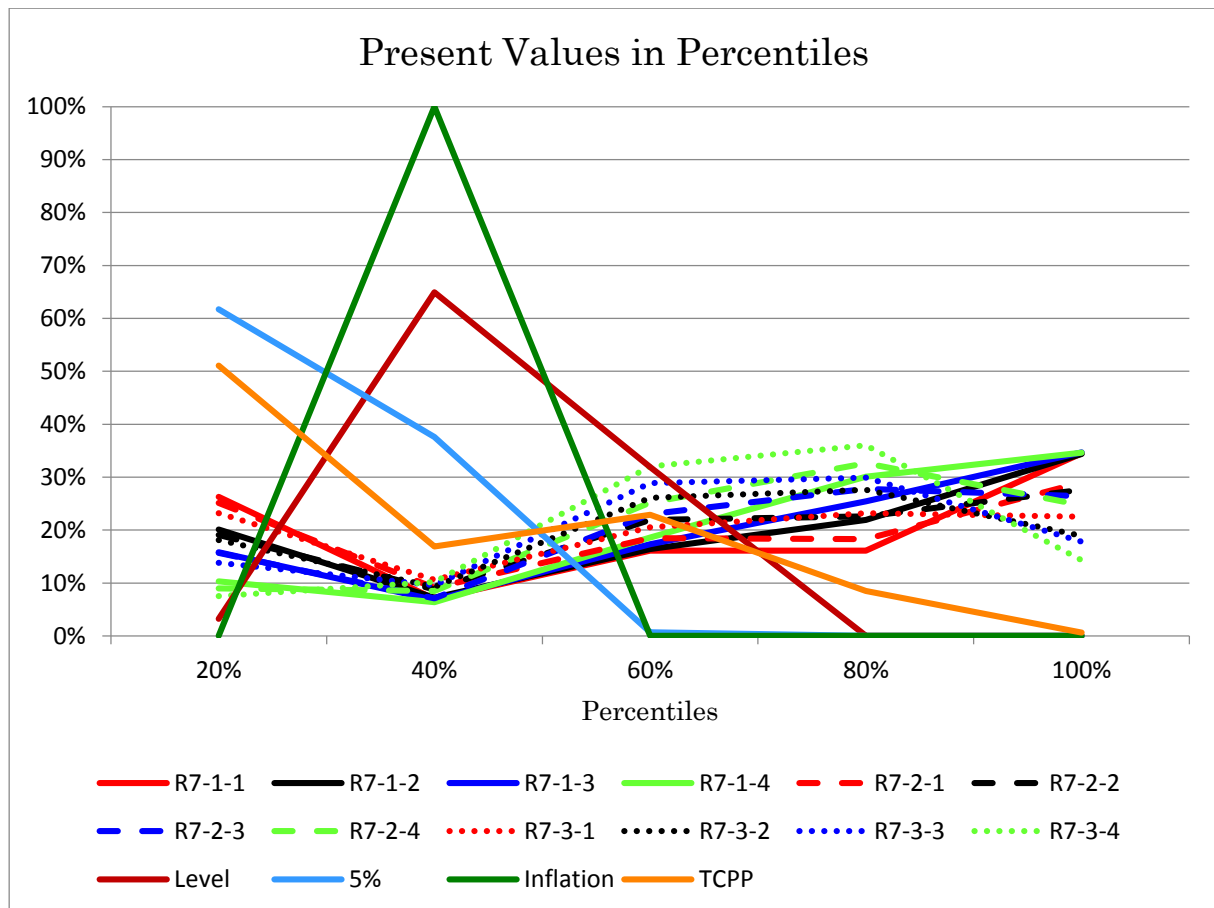


Figure 5.64: Present Values in Percentiles

Source: Author (2015)

5.7.3 Financial Ruin Analysis

Figure 5.65 depicts the ruin percentages that were obtained for retiree case 7. From this figure one can conclude that although the strategies all have marginally lower ruin probabilities than retiree case 6, the R7-1-1 to R7-1-4 strategies are still the only viable options. If a final year ruin probability of 46% is considered acceptable by the retirees one might argue that the conservative 5% initial drawdown strategy could be considered by the retiree and his spouse. The 7.5% initial drawdown strategies all have ruin percentages greater than 90% at the expected death of the spouse.

The R7-1-1 to R7-1-4 strategies have respective ruin probabilities of 10%, 4%, 2%, and 0.3% at the expected death of the spouse. This is an indication of the sustainability of these strategies.

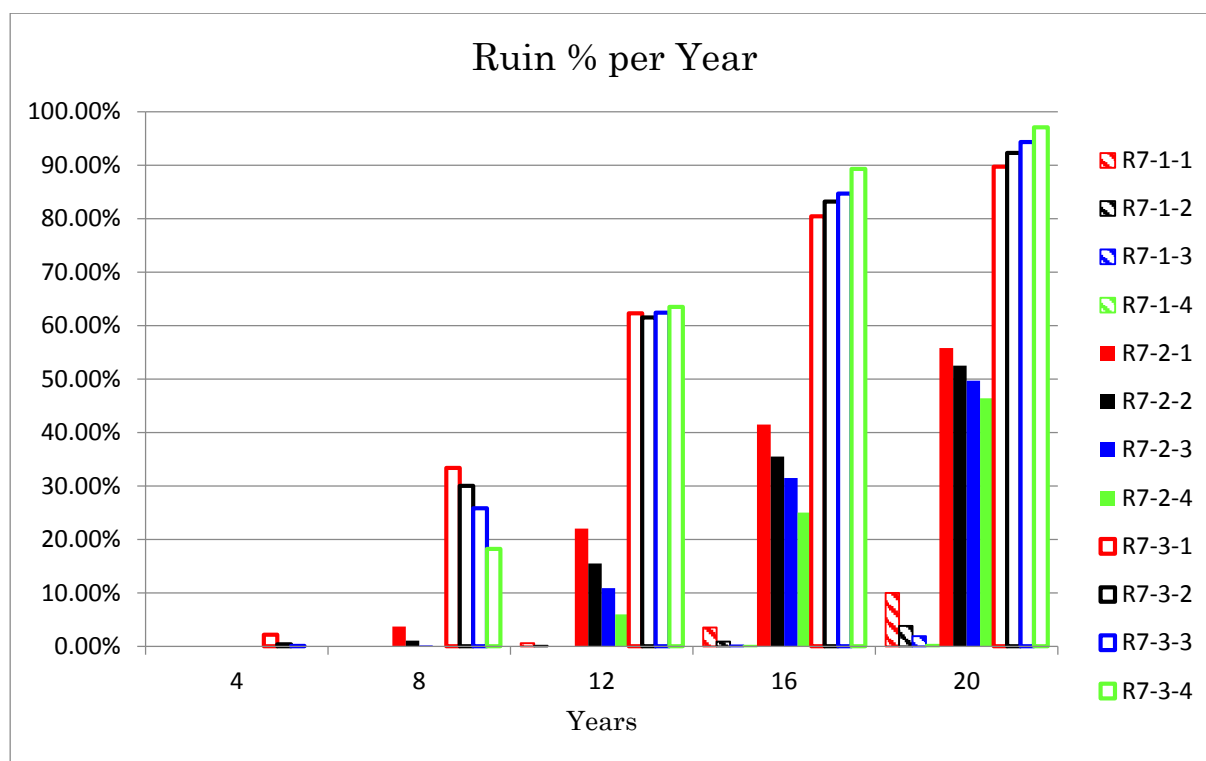


Figure 5.65: Ruin % per Year

Source: Author (2015)

5.7.4 Annuity-to-Terminal Value Analysis

The composition of the total living annuity present values in terms of terminal value and actual lifetime annuity income is presented in Figure 5.66. From a bequest perspective one can argue that the 2.5% initial drawdown strategies are the most attractive strategies. Strategy R7-1-1 returns 49% of total present value in terminal value form, and strategy R7-1-4 returns 57%. The 5% initial drawdown strategies return, on average, around 24% of total present value in terminal value form with the remainder consisting of actual annuity income.

Thus, if the retirees are willing to accept a 46% probability of final year ruin they can invest in a conservative portfolio, draw a higher initial income of 5% and leave 24% of the total present value earned to be inherited by their heirs.

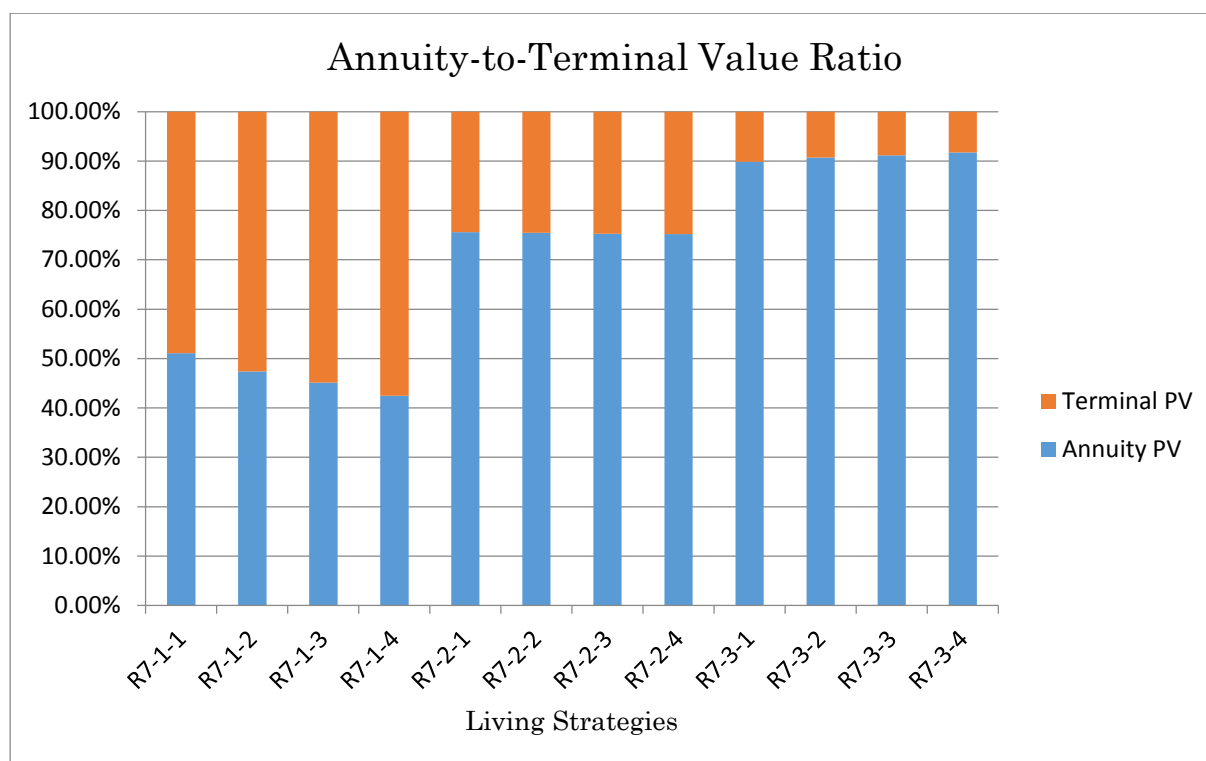


Figure 5.66: Annuity-to-Terminal Value Ratio

Source: Author (2015)

5.7.5 Probability of Outperforming Guaranteed Annuities

When the probability of living annuities outperforming guaranteed annuities on average are considered, as per Figure 5.67, one observes similar results as before. Conservative portfolios have greater outperformance probabilities and aggressive portfolios the smallest. The higher present values of guaranteed level annuities can also be observed in this graph as the probabilities of living annuities outperforming guaranteed level annuities is the lowest. The lowest outperformance probability for the level annuity is equal to 66%. Likewise, the probabilities of living annuities outperforming the 5% escalating annuity is the highest. The lowest outperformance probability, in this case, equals 90%.

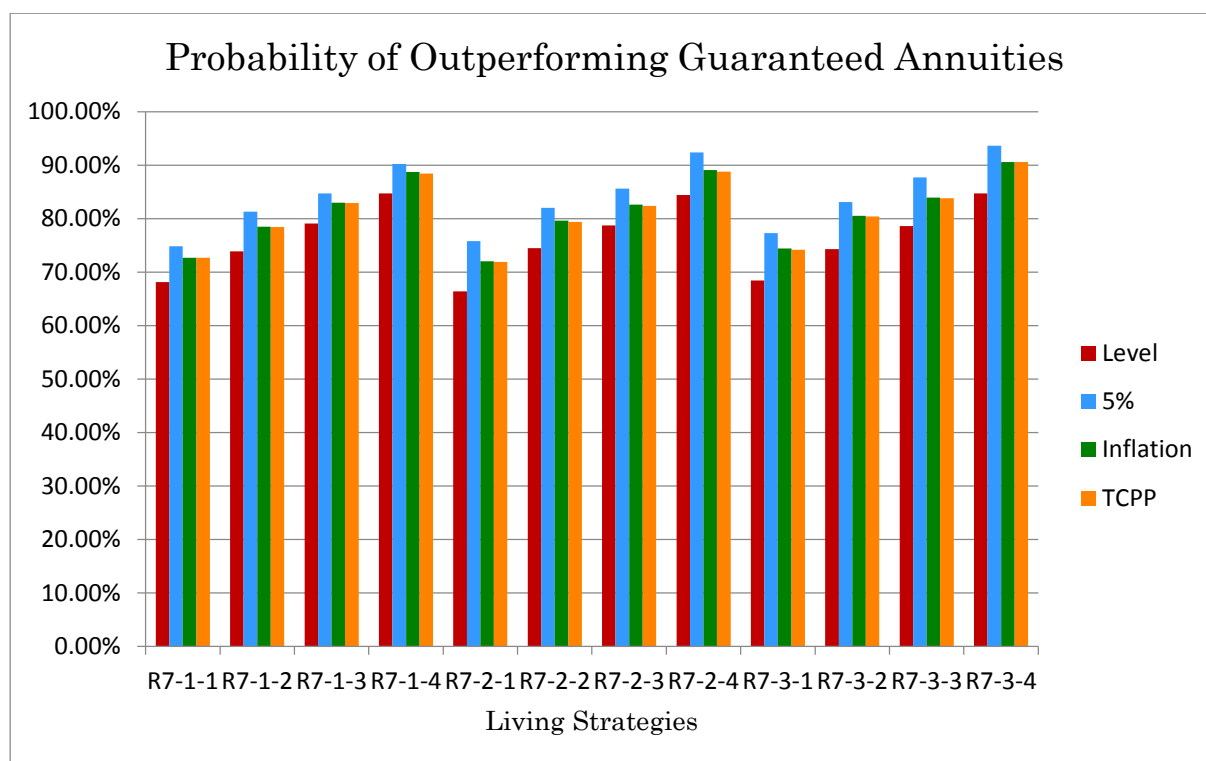


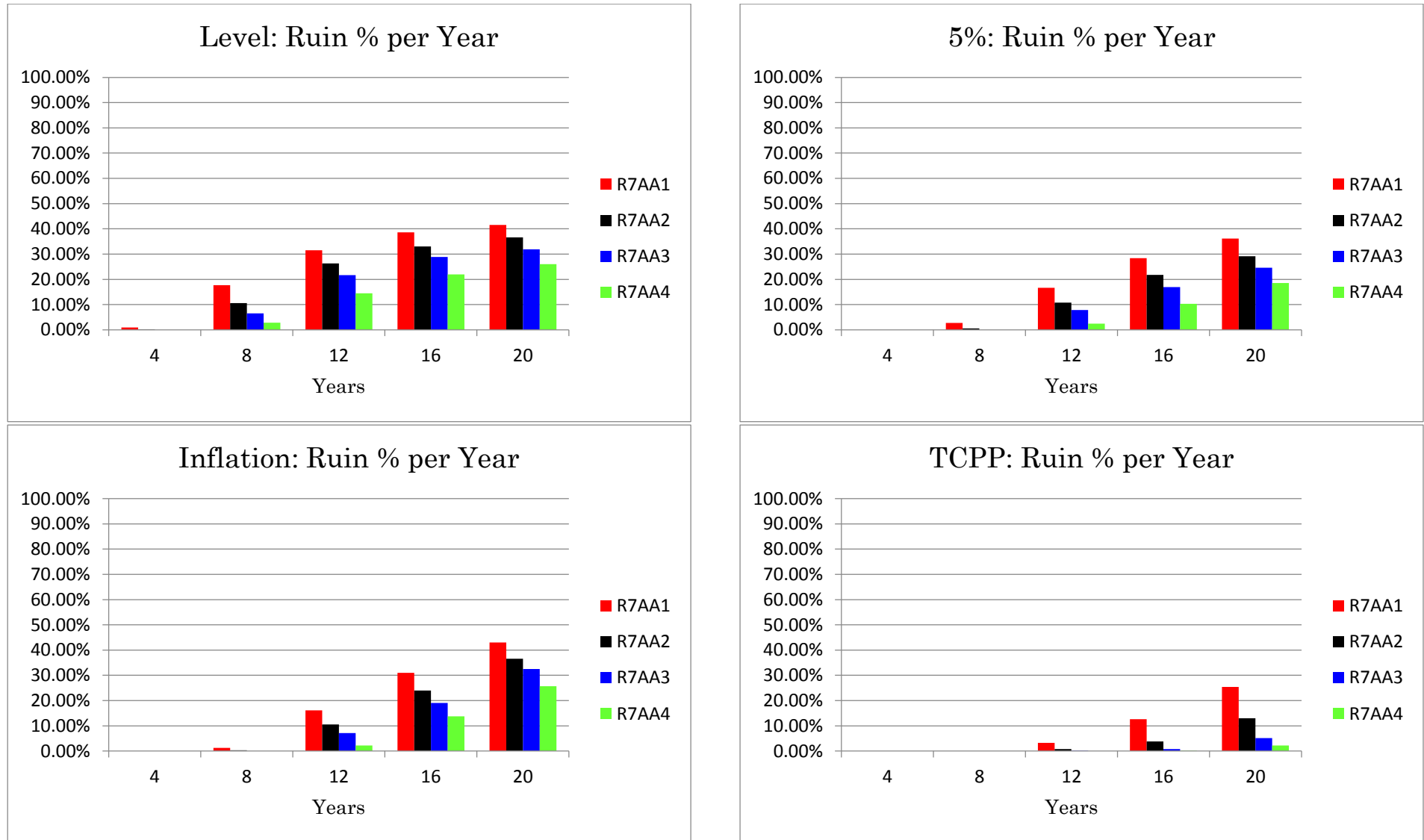
Figure 5.67: Probability of Outperforming Guaranteed Annuities

Source: Author (2015)

5.7.6 Annuity Replacement Model

The results for the Annuity Replacement Model are presented in Figure 5.68. From this it can be concluded that the older annuitants are (specifically couples), the greater the likelihood of simulating the payment profile of guaranteed annuities within a living annuity portfolio. These results then seem to favour living annuities for older persons.

At the expected death of the spouse the results suggest that the couple would have had at least a 60%, 63%, 57%, and 75% chance of replicating level, 5% escalating, inflation-linked, and TCPP annuity income streams, respectively. These are all worst case scenarios as they are derived from the aggressive portfolio probabilities. The results improve for conservative portfolios.

**Figure 5.68: Ruin % per Year**

Source: Author (2015)

5.7.7 Income Stream Comparison

Based on the average monthly income stream analysis, as per Figure 5.69, one can draw specific conclusions. Firstly, it is becoming clearer why the level annuity has a higher present value than the other guaranteed products. This product provides a higher annuity than any of the other guaranteed annuities up to the tenth year. For older annuitants the outperformance gap between the level annuity income and its guaranteed peers is ever increasing. Therefore, it would appear as if the level annuities are becoming more favoured products as the life expectancy of the retirees starts to decrease. However, the TCPP and inflation-linked products still provide an income that is double that of the level annuity at the expected death of the female annuitant.

It is interesting to note that the 5% initial drawdown living annuity strategies now provide an attractive income stream, equalling the 2.5% strategies at the end of the investment horizon. They also offer a competitive income stream when compared to the TCPP and inflation-linked annuities. Specifically, the R7-2-4 strategy outperforms the guaranteed annuities.

Upon further analysis one might conclude that the R7-2-4 strategy is indeed a viable option if a 46% final year ruin probability is considered acceptable. This strategy will provide a competitive income stream relative to guaranteed annuities and returns approximately 24% of the total present value in terminal value form.

However, when an increase in life expectancy is assumed, as per Figure 5.70, it is clear that this is not a *sustainable* option. Ruin percentages will be higher and, above all, the income starts to tail off at year 21. Retirees opting for this strategy are then exposed to significant longevity risk. If their health is in question one might argue that there is merit in this strategy.



Figure 5.69: Average Income Streams

Source: Author (2015)

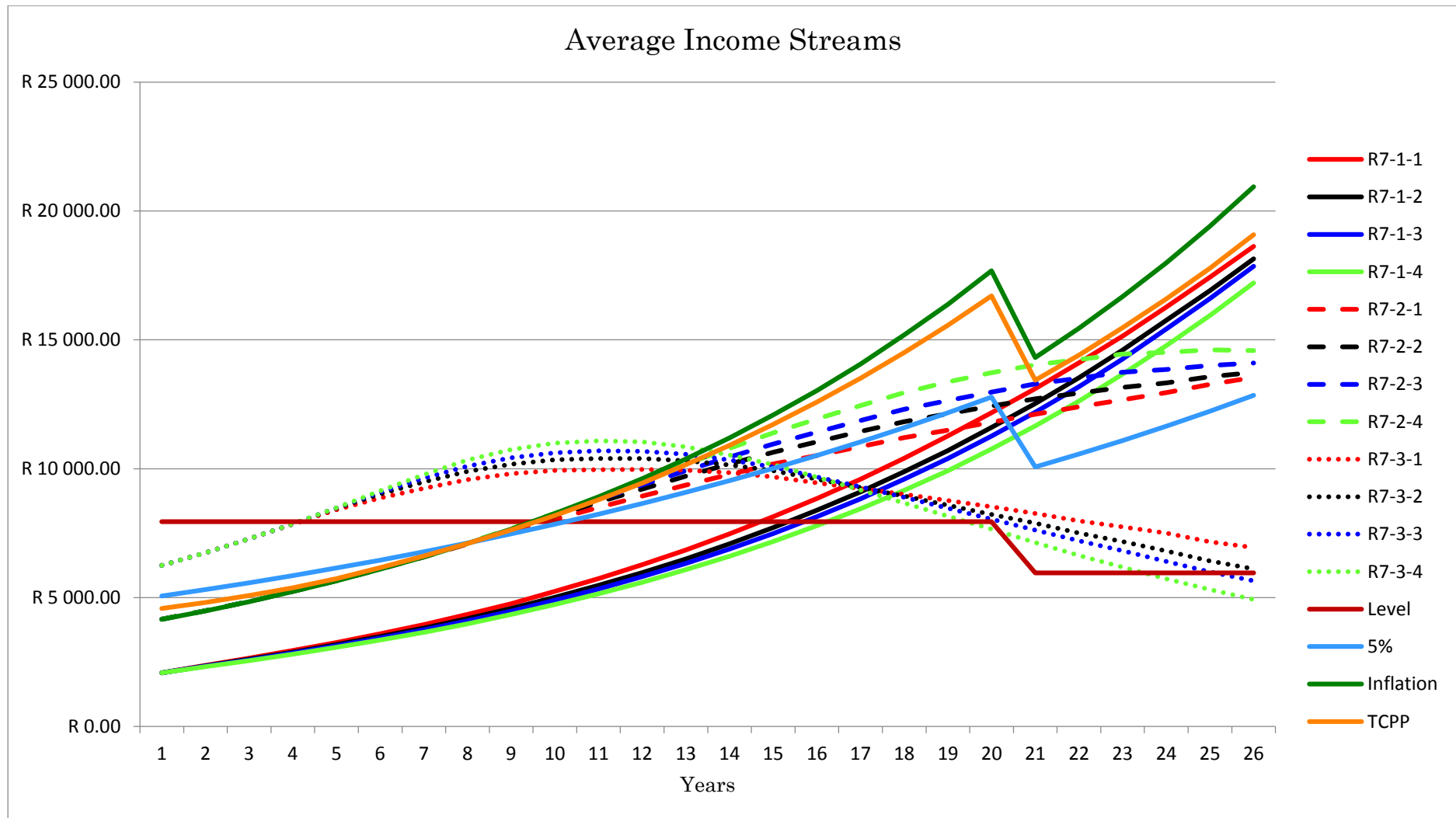


Figure 5.70: Average Income Streams (increased life expectancy)

Source: Author (2015)

5.7.8 Conclusion

The conclusion drawn from the seventh retiree case is that a 65 year-old male retiree with a 62 year-old spouse might be able to invest in a conservative living annuity portfolio and to draw an initial income no greater than 5%. They should, however, definitely draw an initial income greater than 2.5% if they want to have a competitive income stream relative to guaranteed products. The R7-2-4 strategy will provide a competitive income stream at a 46% probability of final year ruin and leaving 24% of the total present value earned in terminal value form.

Should the retirees not be concerned with drawing a competitive income they could opt for a 2.5% initial income. This will provide an ever increasing income at low risk.

From a guaranteed annuity perspective the couple could opt for the TCPP or inflation-linked annuity. If they feel they can manage their living standard and easily adapt to a changing environment, they might consider a level annuity which has the highest present value of all guaranteed products. As mentioned before, the 20 year investment horizon is long and a level income in retirement could expose the retirees to inflation risk.

5.8 Retiree Case 8

This section presents the results that were obtained for a 70 year-old male retiree with a life expectancy of 11 years and who has a spouse, aged 67 with a life expectancy of 16 years.

5.8.1 Present Values Analysis

Figures 5.71 and 5.72 present the present value analysis results for this retiree case. As can be seen from Figure 5.72 the guaranteed level annuity now outperforms the other guaranteed annuities by a significant margin, but is itself outperformed by all living annuity strategies. Furthermore, all guaranteed annuities return present values less than the R1 000 000 mark, whereas all living annuity strategies return present values greater than this.

The overall living annuity ranking still remains the same as in the previous analyses with the R8-1-1 strategy outperforming the other strategies. What can also be seen from Figure 5.71 when compared with the fifth retiree case is the loss in upside potential by the TCPP annuity. This is due to the shorter investment horizon.

The comparison between average present values of retiree cases 5 and 8 is again made here. The differences between the average present values were calculated for each annuity and are presented in Table 5.4. As before, these percentages are negative differences, i.e. the R8-1-1 present value is, for example, 15.31% lower than the present value obtained for the R5-1-1 strategy.

It is reassuring to observe no significant difference between this table and Table 5.1. The tables depict how much value is lost by older annuitants in terms of present values. All the joint-life annuities seem to lose less value than the single-life annuities, though it is believed that this is because the difference in life expectancy for retiree cases 1 and 4 is equal to seven years, and the difference in life expectancy for retiree cases 5 and 8 is equal to five years. The value of guaranteed annuities lies in the annuitant possibly outliving the average life expectancy.

Table 5.4: Average Present Value Differences

Annuity	Difference
Rx-1-1	15.31%
Rx-1-2	13.94%
Rx-1-3	13.79%
Rx-1-4	13.44%
Rx-2-1	8.33%
Rx-2-2	7.45%
Rx-2-3	6.89%
Rx-2-4	6.15%
Rx-3-1	3.33%
Rx-3-2	2.74%
Rx-3-3	2.42%
Rx-3-4	2.06%
Level	11.42%
5%	15.78%
Inflation	18.66%
TCPP	17.99%

Source: Author (2015)

A six year increase in the life expectancy of both retirees leads to the average present value results presented in Figure 5.73. It is interesting to note that a prior result does not hold anymore: the 5% escalating annuity does not outperform the guaranteed level annuity for this retiree case, given the increase in life expectancy. The inflation-linked annuity benefits most from this increase and slightly outperforms the TCPP product. However, it is still the case that none of the present values of the guaranteed annuities are greater than the living annuity present values.

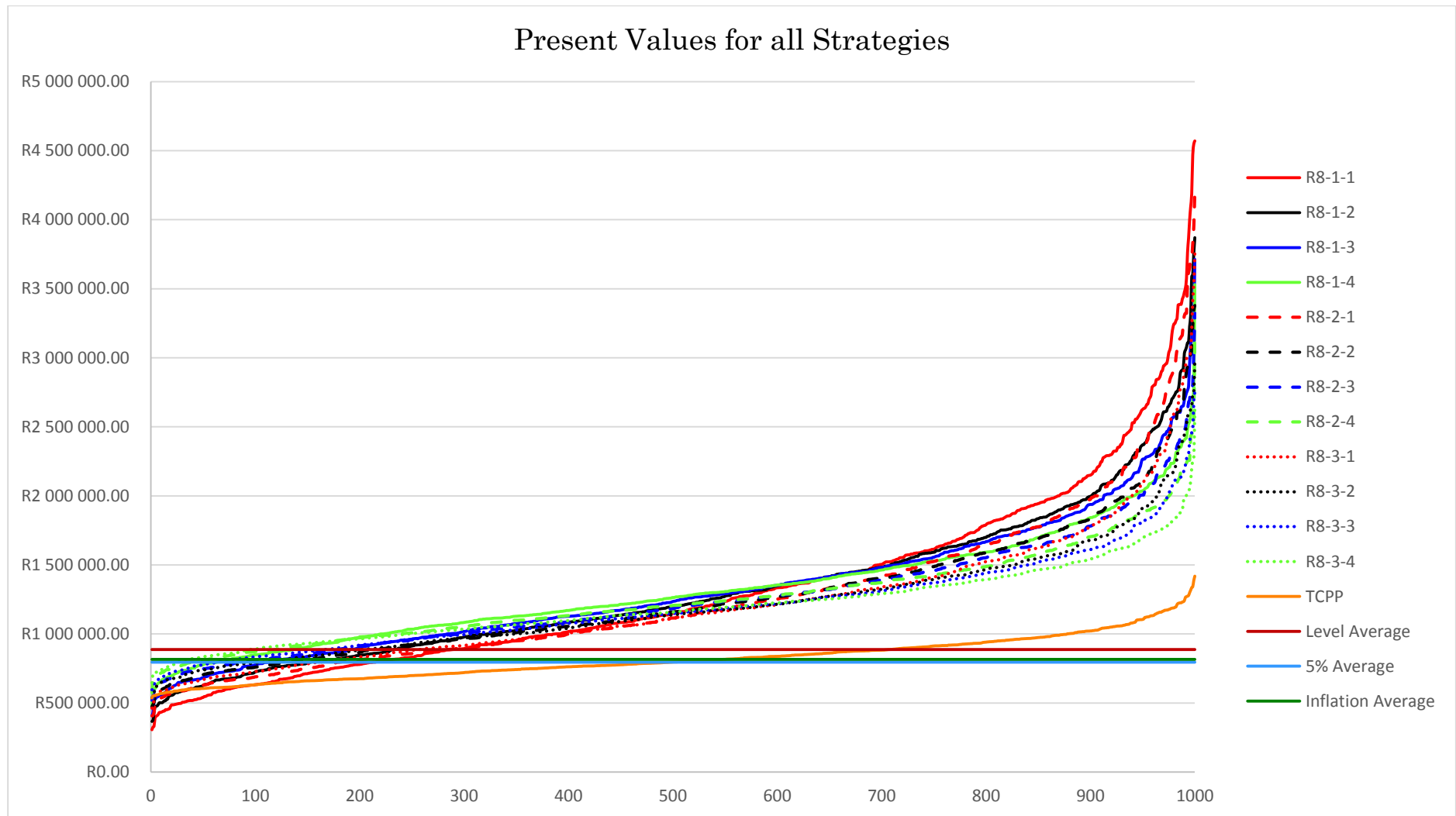


Figure 5.71: Present Values for all Strategies

Source: Author (2015)

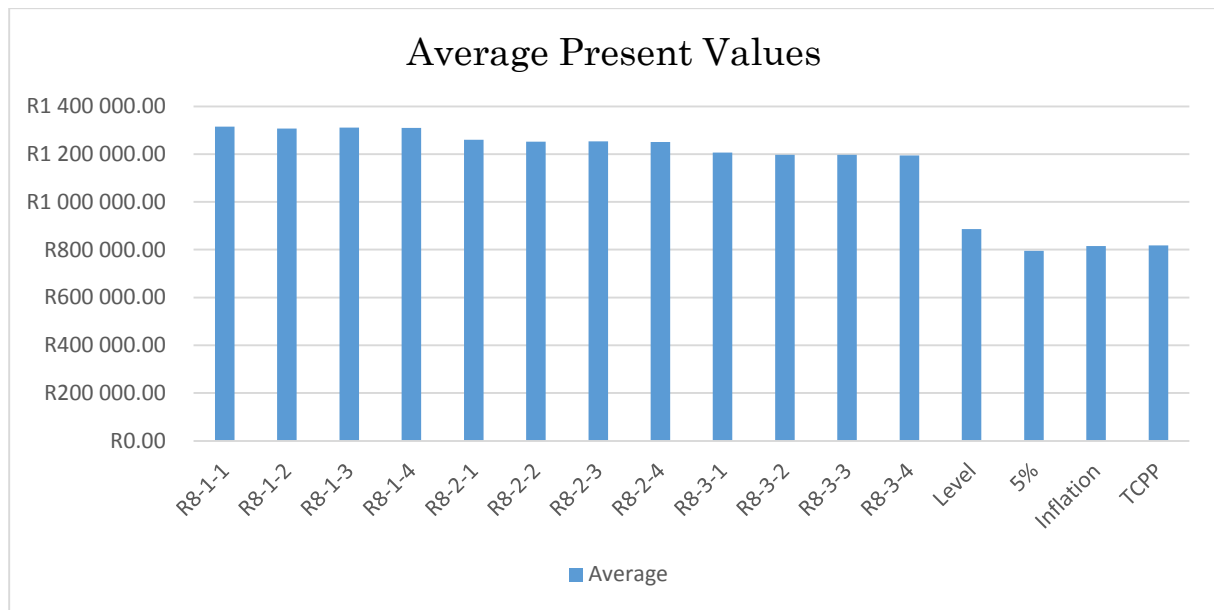


Figure 5.72: Average Present Values

Source: Author (2015)

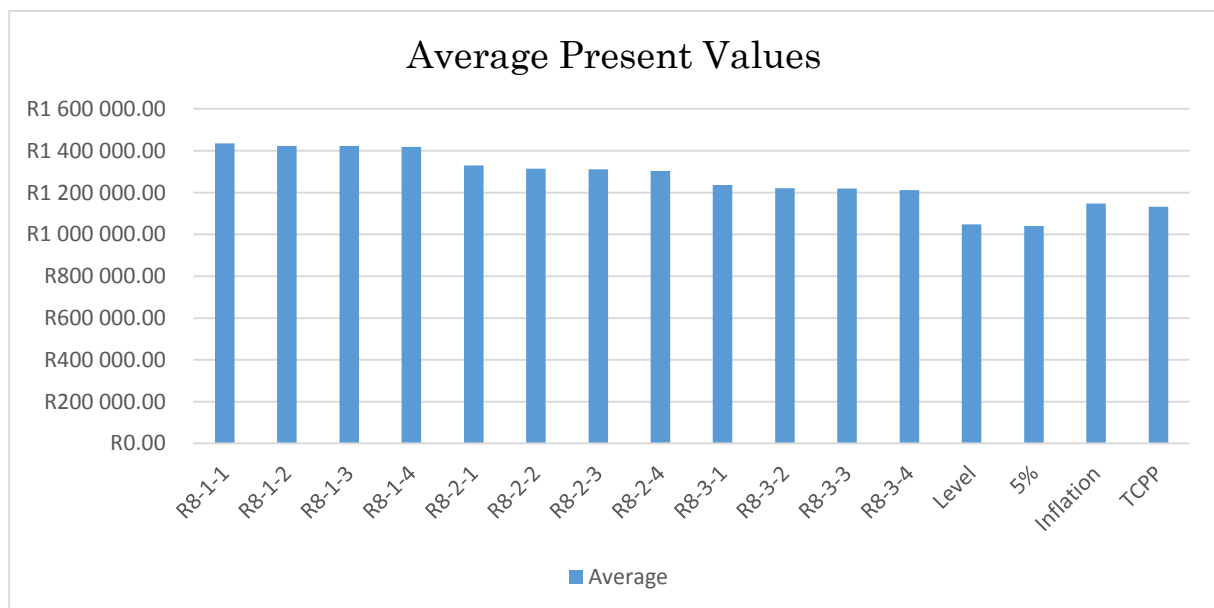


Figure 5.73: Average Present Values (increased life expectancy)

Source: Author (2015)

5.8.2 Percentile Analysis

An analysis of the percentile figure reveals that the R8-1-4 living annuity strategy does not provide the same level of outperformance as it did in, for example, retiree case 5. It does still perform relatively well in that 8% of its total observations are below the 20th percentile, which is the third lowest percentage obtained, and that 33% of its total observations are between the 80th and 100th percentiles. The strategy loses out in the midrange percentiles. Considering that the R1 000 000 mark is around the 48th percentile one would prefer to see most observations lie above the 60% percentile mark in Figure 5.74.

From a pure guaranteed annuity perspective one can see that the 5% escalating annuity clearly performs worst, not only from a present value perspective, but also from a percentile perspective. The TCPP annuity also has a large number of observations below the 20th percentile, but at least has 23%, 19%, and 4% of observations in the 20th to 40th, 40th to 60th and 60th to 80th percentile ranges, respectively. The present values of the level annuity are spread across the 20th to 40th and 40th to 60th percentiles with 85% of its total observations being in the former, and 15% being in the latter.

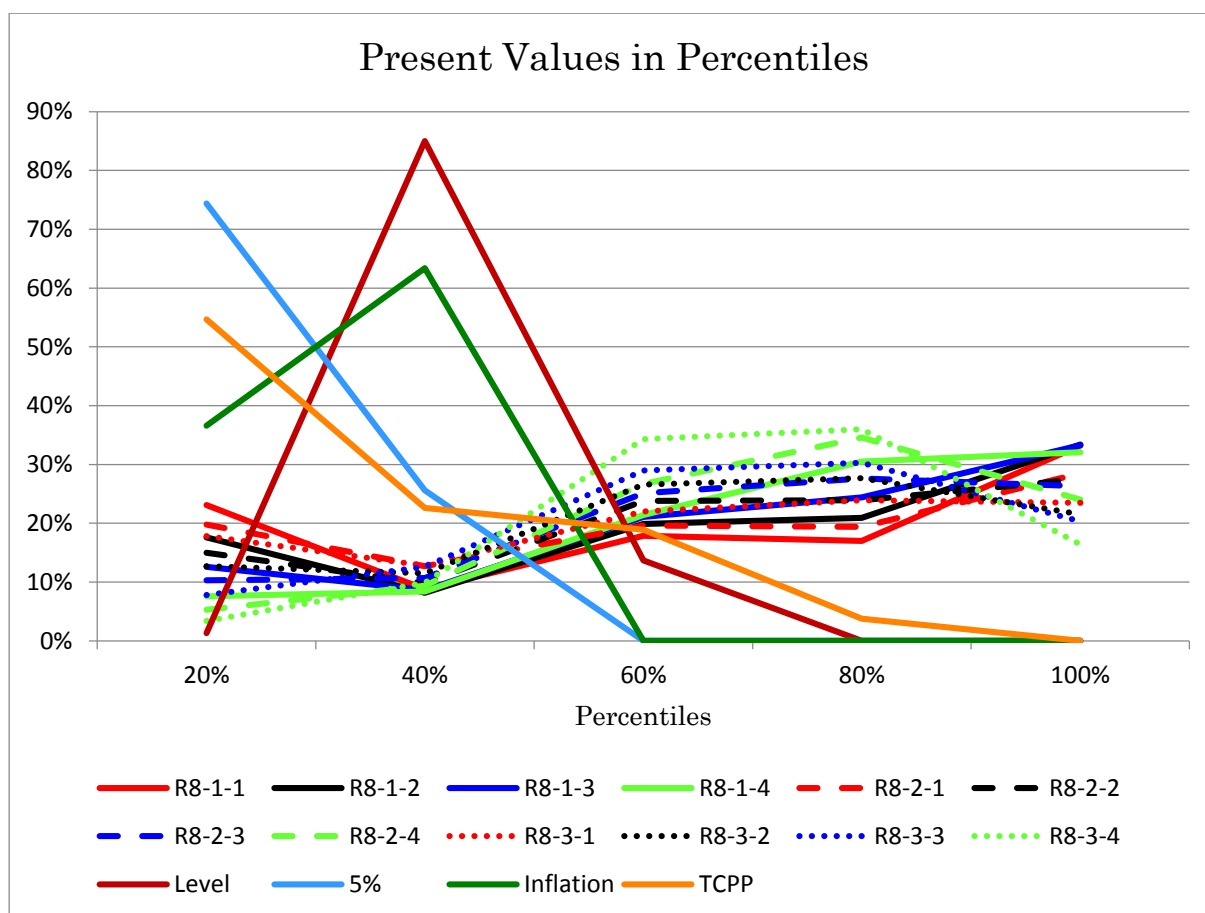


Figure 5.74: Present Values in Percentiles

Source: Author (2015)

5.8.3 Financial Ruin Analysis

The ruin analysis provides a better understanding of the optimal living annuity strategy. One can conclude that, based on Figure 5.75, the 5% initial drawdown strategy does indeed seem to be a viable, but still risky, strategy. It has a maximum final year ruin probability of 41% for the aggressive asset allocation and a minimum of 25% for the conservative portfolio at the spouse's death. The 7.5% initial drawdown strategy is not a feasible option as these strategies have a minimum final year ruin probability of 80%.

In conclusion then, if the retirees are willing to accept a 25% probability of final year ruin they may well consider a living annuity with an initial drawdown rate of 5%. Whether or not the strategy delivers a sufficient return in terms of the retirees' bequest motive as well as a competitive income stream is analysed next.

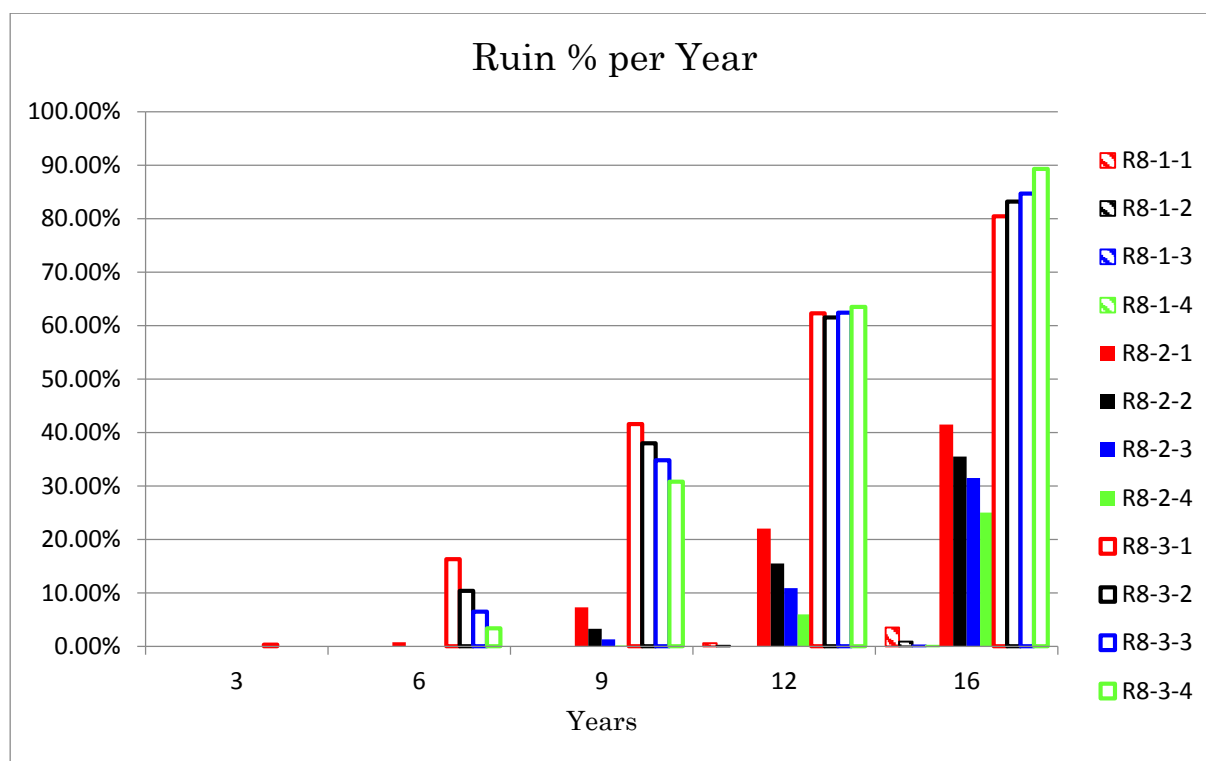


Figure 5.75: Ruin % per Year

Source: Author (2015)

5.8.4 Annuity-to-Terminal Value Analysis

When the bequest motive is analysed one can see that the 2.5% initial drawdown strategy together with a conservative portfolio delivers 65% of total present value in terminal value form. Figure 5.76 further shows that the comparable figure for the aggressive portfolio is 58%. The 5% initial drawdown strategy delivers 36% of the total present value in terminal value form when a conservative strategy is followed and 33% when an aggressive portfolio is implemented. The 7.5% initial drawdown strategy delivers a maximum of 17% of the total present value in terminal value form which is an indication of its high ruin probabilities.

One can thus conclude that the retirees might consider the 2.5% or 5% initial drawdown strategies if they have a bequest motive, although the 5% strategy does not leave too much money remaining after both retirees have passed away.

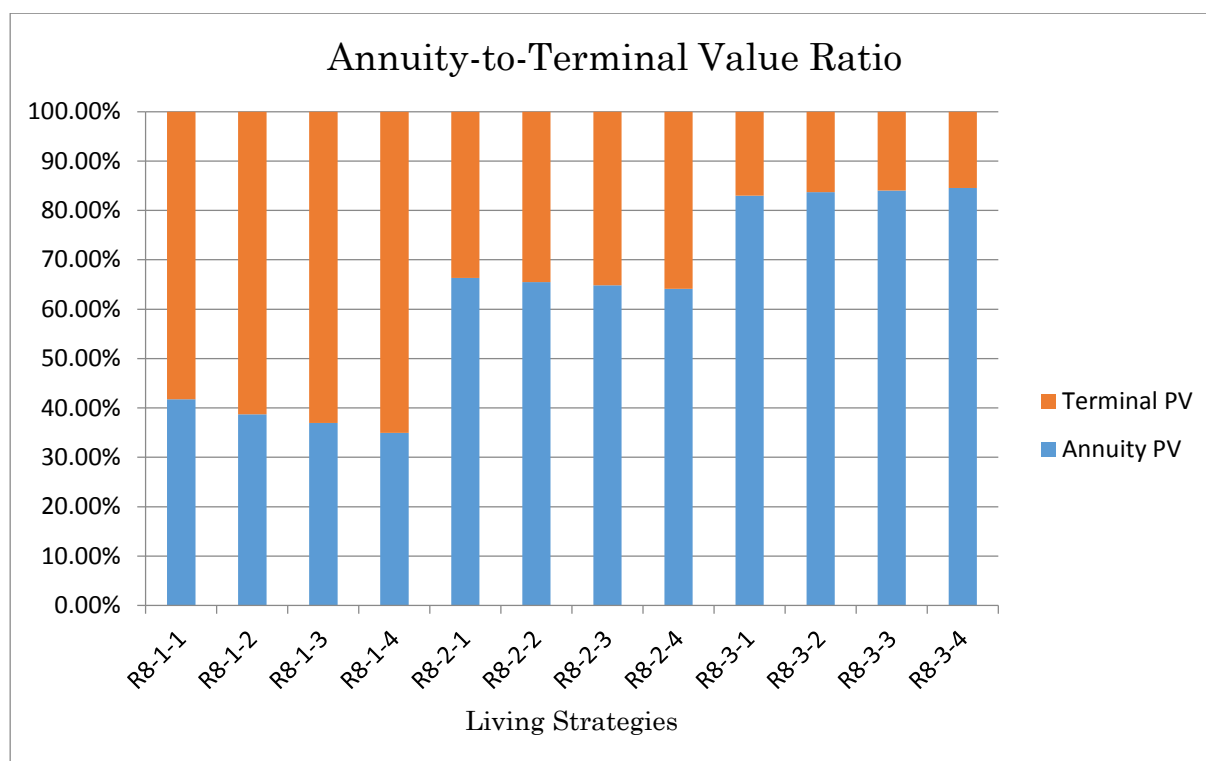


Figure 5.76: Annuity-to-Terminal Value Ratio

Source: Author (2015)

5.8.5 Probability of Outperforming Guaranteed Annuities

The probabilities of living annuities outperforming guaranteed annuities on average are presented in Figure 5.77. From this it is clear that the 7.5% initial drawdown strategies have relatively higher ruin probabilities in comparison with the 2.5% and 5% strategies. However, as we will see, this result proves to be insignificant as this strategy has too great a ruin probability.

The living annuity strategies have the highest probabilities of outperforming the 5% escalating annuities equalling a maximum of 97% for the R8-3-4 strategy. Level annuities again prove to be the most difficult to outperform as the living annuities have a maximum outperformance probability of 90% for the R8-3-4 strategy.

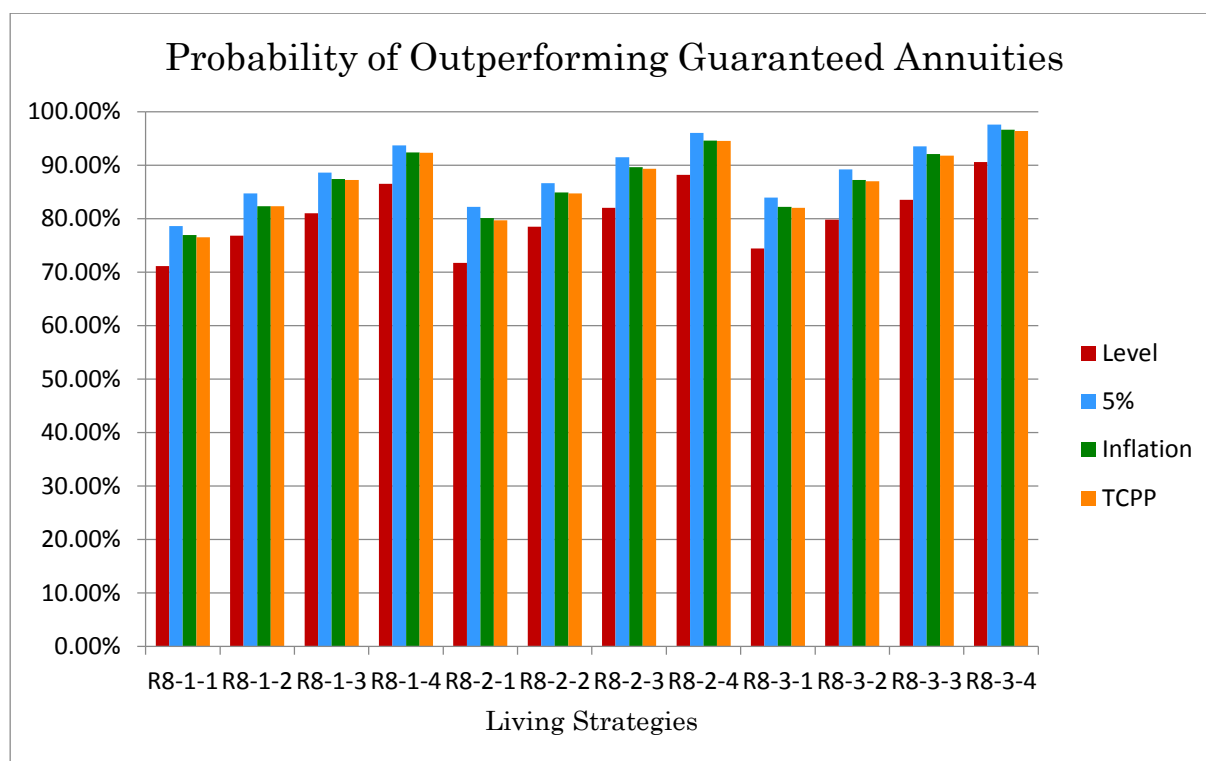


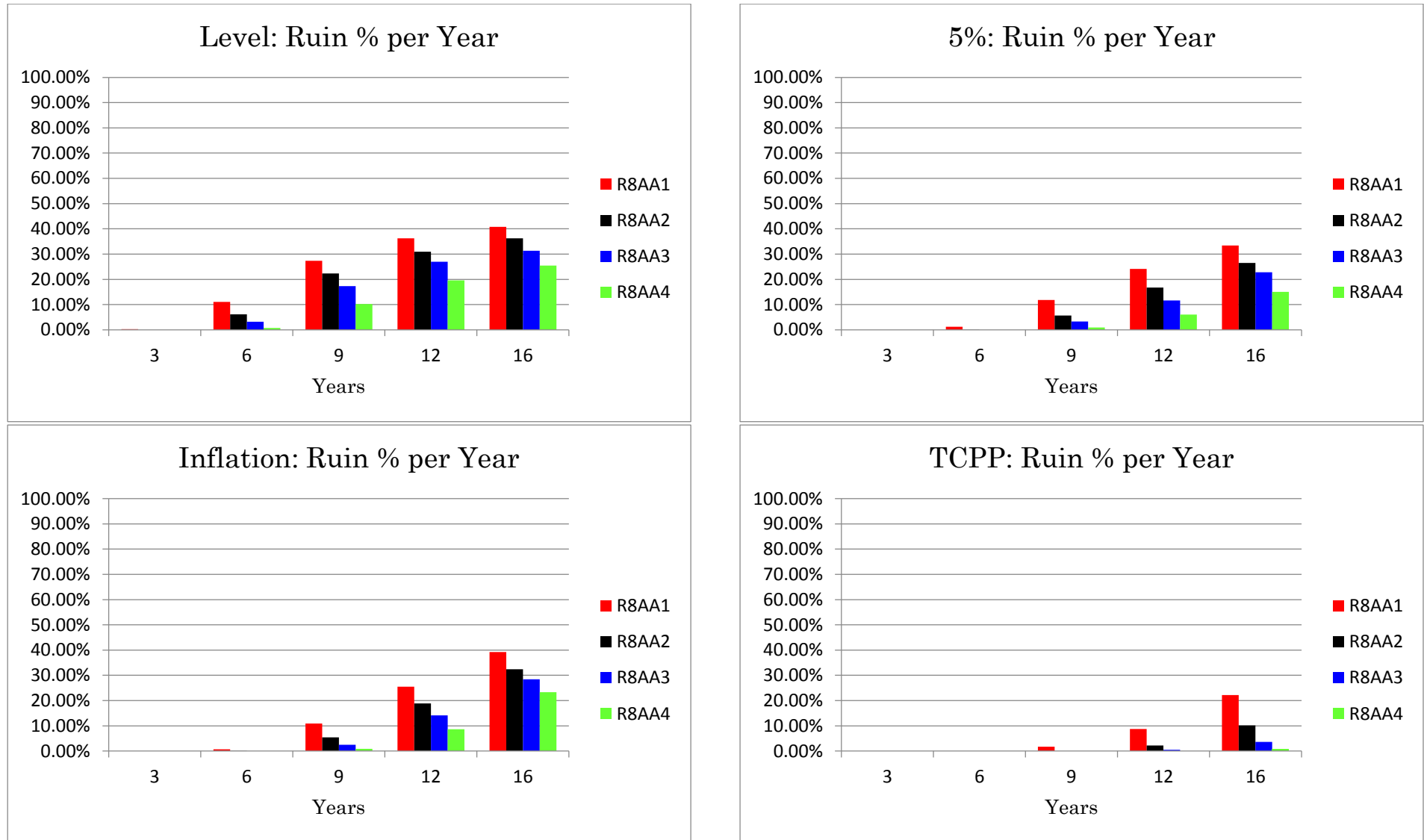
Figure 5.77: Probability of Outperforming Guaranteed Annuities

Source: Author (2015)

5.8.6 Annuity Replacement Model

The ARM proves, as per Figure 5.78, that a living annuity portfolio would have the greatest difficulty in simulating a guaranteed level annuity for this retiree case. The aggressive portfolio has a final year ruin probability of 40% and the conservative portfolio a final year ruin probability of 25%. The inflation-linked annuity has similar ruin probabilities, but is lower than that of the level annuity. The 5% escalating annuity in turn has somewhat lower ruin percentages than the inflation-linked product. The TCPP annuity has a final year ruin probability of 22% and 0.9% for the aggressive and conservative portfolios, respectively.

The TCPP product therefore proves to be safest to replicate within a living annuity portfolio context. These ruin probabilities are best interpreted together with the comparison of income streams which is analysed in Section 5.8.7.

**Figure 5.78: Ruin % per Year**

Source: Author (2015)

5.8.7 Income Stream Comparison

Figure 5.79 depicts the different monthly income streams for each of the annuities. From this it is clear that the R8-2-1 to R8-2-4 strategies only surpasses each of the guaranteed annuities at or after the male annuitant's death. The 7.5% initial drawdown strategy manages to return a high income during the life of the retirees, but this comes at too great a ruin probability. The R8-1-1 to R8-1-4 strategies are the safest options, but fail to provide a competitive income stream relative to the guaranteed products during the life of the retirees.

One could thus argue that the retirees may follow the R8-2-4 strategy which will provide an ever-increasing income stream in retirement and is further supported by the bequest motive results. It is interesting to note that this strategy comes at a final year ruin probability of 25%, whereas the inflation-linked and TCPP annuities can be simulated at maximum final year ruin probabilities of 39% and 22% respectively, based on the ARM.

The true value of the level annuity is difficult to see in these types of figures. It is important to note that the level annuity returned a much higher present value than the other guaranteed annuity options under normal life expectancy conditions. When life expectancy is increased by six years for each of the retirees one can see the benefit of owning a guaranteed annuity. Figure 5.80 depicts the increased life expectancy income streams. The living annuity strategies cannot provide a competitive income stream and would have higher ruin probabilities than what was stated under average life expectancies.

Thus, any of the guaranteed annuities, except the 5% escalating annuity, may be considered for this couple. The R8-2-4 strategy is also an option, as mentioned above.



Figure 5.79: Average Income Streams

Source: Author (2015)



Figure 5.80: Average Income Streams (increased life expectancy)

Source: Author (2015)

5.8.8 Conclusion

In conclusion, it was found that a 70 year-old male retiree who has a 67 year-old spouse may well consider the R8-2-4 living annuity strategy under the following constraints: a minimum probability of final year financial ruin equal to 25% has to be accepted along with the knowledge that only 36% of the total present value earned by the strategy will be available to their heirs at their death. These conditions will provide a similar income stream as the inflation-linked and TCPP products.

Should the annuitants not wish to accept this risk they could opt for the level, TCPP or inflation-linked products. The level annuity offers a greater present value and a fixed income stream which makes tasks such as budgeting easier, but it comes down to personal preference. One can argue that if the retirees are able to maintain a certain living standard below that of the level income, and preferably be able to adjust it downward at a later stage, they may consider the level annuity.

Chapter 6

Conclusions, Limitations, and Future Research

This chapter discusses the conclusions drawn from the study. Sections 6.1 and 6.2 present the main findings, Section 6.3 the limitations of the study, and Section 6.4 the possible focus areas for future research.

6.1 Conclusions

Firstly, it should be noted that purchasing an annuity is an immensely subjective decision. The individual circumstances of each retiree will have a significant influence on his eventual decision. There is, unfortunately, no one size fits all solution. This study does, however, provide evidence in terms of generalised retiree cases for certain types of annuities and strategies.

The following sections summarise the results for each of the retiree cases analysed.

6.1.1 Retiree Case 1

The results showed that a 55 year-old male retiree may consider the R1-2-4 living annuity strategy if he wants to achieve a similar income stream to the 5% escalating annuity. This exposes him to a final year ruin probability of approximately 50% and results in him being able to leave an inheritance equal to 22% of total present value earned. Should he not be concerned with matching the guaranteed income he may opt for any of the 2.5% initial drawdown strategies which have a maximum final year ruin probability of 12%. These strategies, however, provide an uncompetitive income stream relative to guaranteed annuities.

If the strategies above are not deemed as feasible solutions he could invest in either the TCPP or inflation-linked annuity. Although the level annuity provides a higher present value it is argued that his life expectancy of 21 years is too long for him to receive a *constant* income stream. It may be argued that medical costs rise with age and that old age care will also come

into play during the final years of a retiree's life. Such a retiree will subsequently be in a better position if he accepts a lower income in earlier years and an increasing income in the latter part of his retirement.

The ARM results showed that he had respective maximum final year ruin probabilities of 48% and 54% when the TCPP and inflation-linked annuities were simulated within the living annuity portfolio. These guaranteed products, of course, provide a risk-free income.

6.1.2 Retiree Case 2

The conclusions for a 60 year-old male retiree were similar to those of a 55 year-old retiree. He may also consider the R2-2-4 living annuity strategy if he wants to achieve a similar income stream to the 5% escalating annuity. The inflation-linked and TCPP annuity, however, provide higher income streams than the 5% escalating annuity. The R2-2-4 has a final year ruin probability of 30% and returns 30% of total present value earned in terminal value form. The R2-1-1 to R2-1-4 strategies are also feasible and have a maximum final year ruin probability of 5%. These strategies, however, provide an uncompetitive income stream but do provide attractive benefits should the bequest motive be important.

If the living annuity strategies above are not suitable solutions for the retiree he may opt for either the TCPP or inflation-linked annuity. The level annuity does provide a higher present value under average life expectancy conditions, but the same argument is made as in the case of the first retiree in that his life expectancy of 18 years is too long to receive a constant income stream. The ARM results showed that he had respective maximum final year ruin probabilities of 53% and 55% when the TCPP and inflation-linked annuities were simulated within the living annuity portfolio.

6.1.3 Retiree Case 3

From this study it was concluded that a 65 year-old male could consider any of the R3-1-1 to R3-1-4 living annuity strategies which have virtually no probability of final year ruin. Any of the R3-2-1 to R3-2-4 strategies may also be considered if a maximum final year ruin probability equal to 32% is deemed acceptable. However, none of these strategies provide a

competitive income stream relative to the guaranteed annuities. The 2.5% initial drawdown strategies offer the benefit of a maximum bequest equal to 69% of total present value earned in terminal value form. The 5% initial drawdown strategies offer a maximum of 42% of total present value earned in terminal value form.

If the retiree is not concerned about leaving an inheritance he may opt for either the TCPP, inflation-linked, or level annuity. The level annuity again provides the highest present value given the average life expectancy conditions. It is argued that the 14 year life expectancy seems short enough to receive a constant income stream. The income stream of the level annuity is only surpassed by the other annuities at the halfway mark of his life expectancy. The living expenses of this annuitant should, however, be carefully managed. The TCPP and inflation-linked annuities outperform the other guaranteed products when an increase in life expectancy is assumed.

The ARM results suggest that the retiree would have had to assume respective maximum final year ruin probabilities of 47% and 51% when the TCPP and inflation-linked annuities were simulated within the living annuity portfolio.

6.1.4 Retiree Case 4

The results showed that the R4-3-4 strategy is the only living annuity option for a 70 year-old male retiree if he wants to achieve an income stream similar to the income streams offered by the guaranteed products. This strategy comes at a final year ruin probability of 54% and offers a bequest opportunity equal to 32% of total present value earned. Should he not be concerned with matching the guaranteed income stream he may opt for any of the other 2.5% initial drawdown strategies. These strategies have a maximum final year ruin probability of 0.4% and leaves approximately 73% of the total present value earned in terminal value form. Any of the 5% initial drawdown strategies may also be followed. These strategies have a maximum final year ruin probability of 16% and leaves approximately 52% of the total present value earned in terminal value form.

Either of the level, TCPP or inflation-linked products may be opted for if guaranteed annuities are considered. The level annuity, again, provides the highest average present value under normal life expectancy assumptions. It is argued that the eleven year life expectancy is now definitely short enough to receive a constant income stream, especially since the income

stream is higher than the TCPP or inflation-linked income in the first seven of those eleven years.

The ARM results showed that the retiree had respective maximum final year ruin probabilities of 56%, 47%, and 51% when the level, TCPP and inflation-linked annuities were simulated within the living annuity portfolio. These results confirm the attractiveness of guaranteed products.

6.1.5 Retiree Case 5

The joint-life results showed that the only feasible living annuity strategies for a 55 year-old male retiree with a 52 year-old female spouse are the R5-1-1 to R5-1-4 strategies. These do offer somewhat competitive income streams although mainly doing so after the male annuitant's death. The R5-1-4 strategy has a final year ruin probability of 5.6% and 43% of the total present value received is expected to be in the form of terminal value. The other initial drawdown strategies do not have acceptable ruin probabilities.

If the retirees do not wish to accept these living annuity conditions they may opt for either the TCPP or inflation-linked annuity. These annuities deliver present values that now match the level annuity given the average life expectancy assumed. Furthermore, the ARM results indicate that the income streams in respect of the TCPP and inflation-linked products could only be simulated at maximum final year ruin probabilities of 28% and 46%, respectively.

6.1.6 Retiree Case 6

For a 60 year-old male retiree with a 57 year-old female spouse the results indicated that they could follow any of the R6-1-1 to R6-1-4 living annuity strategies as these have respective final year ruin probabilities of 20%, 11%, 6% and 2.5%. However, they do not provide a competitive income stream, whereas the 5% initial drawdown strategies that do provide a competitive income stream do so at too high a ruin probability. The 2.5% initial drawdown strategies provide the option to leave approximately 45% of the total present value earned by the retirees in the form of terminal value.

If the retirees do not wish to accept these living annuity features they may purchase either the TCPP or inflation-linked annuity. These annuities deliver sub R1 000 000 present values but provide an increasing income stream in retirement that outperforms the 2.5% initial drawdown living annuity strategies. The ARM results also suggest that the retirees would have had to assume respective maximum final year ruin probabilities of 29% and 46% when the TCPP and inflation-linked annuities were simulated within the living annuity portfolio.

6.1.7 Retiree Case 7

The results for a 65 year-old male retiree with a 63 year-old female spouse showed that they may consider the R7-2-4 living annuity strategy as a feasible option if they are concerned with receiving a competitive income stream in comparison with guaranteed annuities. This strategy has a final year ruin probability of 46% while leaving 24% of the total present value earned in terminal value form at the death of both retirees. The 2.5% initial drawdown strategies do not provide a competitive income stream but do enable the retirees to leave approximately 55% of the total present value earned in terminal value form.

If these are not acceptable options the retirees may again opt for either the TCPP or inflation-linked annuity. These annuities do not provide present values greater than R1 000 000 when average life expectancies are assumed, but do provide attractive guaranteed increasing income streams over the life of the retirees. Results from the ARM test shows that the income streams of the TCPP and inflation-linked products can be replicated within a living annuity portfolio if a maximum final year ruin probability of 25% and 43% respectively is assumed.

6.1.8 Retiree Case 8

This study showed that a 70 year-old male retiree with a 67 year-old female spouse may consider the R8-2-4 living annuity strategy. This strategy provides 36% of the total present value earned in terminal value form at a final year ruin probability of 25%. The 2.5% initial drawdown living annuity strategies have lower ruin probabilities and provide approximately 63% of the total present value earned in terminal value form, but they do not have competitive income streams relative to the guaranteed products.

From a guaranteed annuity perspective the annuitants may consider the level, TCPP or inflation-linked annuities. While the present values from these products are significantly below the R1 000 000 mark they offer a guaranteed income stream during the relatively short lives of the retirees. Furthermore, the ARM results suggest that the retirees would have had to assume respective maximum final year ruin probabilities of 40%, 22% and 39% when the level, TCPP and inflation-linked annuities were simulated within the living annuity portfolio.

6.2 General Conclusions

6.2.1 Present Values

An important conclusion to be drawn from the study was that all living annuity strategies outperformed guaranteed annuities based on an average present value analysis. However, this was only true for average life expectancy conditions. When a six year increase in the life expectancy of all retirees was assumed the TCPP and inflation-linked annuity provided higher average present values than certain living annuity strategies. Furthermore, for each of these increased life expectancy cases the guaranteed annuities provided risk-free present values greater than R1 000 000. This result highlights the longevity protection that guaranteed annuitants benefit from.

6.2.2 Guaranteed Annuities

The level annuity was the better performing guaranteed annuity on a present value analysis when average life expectancies were assumed. However, it was emphasised that the retirees still assume inflation risk when opting for a level income in retirement. For instance, the female annuitant in retiree case 5 had a life expectancy of 28 years. A level income for such a long period could perhaps expose the retirees to behavioural bias.

One could argue that if two different income streams had the same present value, but the one had a constant income stream and the other an increasing income, retirees would rather opt for increasing incomes. Young retirees that live healthy lifestyles, have a good medical history, and no serious family illnesses should consider increasing income stream products as opposed to the conventional constant income stream. It would be more logical to conclude that a

retiree who receives an increasing income in the latter part of his life will be better off than receiving a constant income. If medical costs start rising due to ill health one would rather want to be assured of an increase in your income as opposed to receiving the same amount.

Furthermore, the 5% escalating annuity outperforms the level annuity when an increase in life expectancy is assumed. The TCPP and inflation-linked products also provide higher present values.

In turn, the TCPP and inflation-linked annuities offered similar present values, but the TCPP annuity offers the annuitants up- and downside exposure. The ARM also suggested that the underlying living annuity portfolio is more sustainable when replicating the TCPP annuity as opposed to the inflation-linked product. The TCPP had an average final year ruin probability of 25% in comparison to 42% in the case of the inflation-linked product.

This result indicates that there might indeed be room for new annuity products in the industry. The sales of with-profits annuities have declined over the past few years as retirees are looking for other products that fulfil their needs. The TCPP annuity thus offers an alternative to the conventional options. Most importantly, the product is structured in a transparent way which makes it easier for retirees to comprehend.

6.2.3 Living Annuities

When considering living annuities it is important to note the significance of achieving positive returns in the initial years of your retirement. This implies having knowledge about the investment industry and knowing how to allocate the underlying portfolio. Goemans and Ncube (2008:36) showed how negative returns in the first year affect living annuitants' income in subsequent years. This is further amplified by the fact that retirees do not have control over market returns. For example, if a person retired in August 2008, which many people surely did do, he/she would have been exposed to two consecutive months in which the ALSI decreased by more than 10% in each month. This would have significantly reduced his/her retirement capital. The timing of one's retirement thus plays an important role in your post-retirement success, whereas guaranteed annuitants are not exposed to this risk.

In terms of asset allocation it appeared as if the most conservative portfolio, consisting of 60% bonds, 35% equities, and 5% property, was the optimal solution. This is in accordance

with Goemans and Ncube (2008:34) and Beinash (2007:23). It would appear that it is more important to correctly manage one's drawdown than making the correct asset allocation.

The study also showed that living annuities could provide competitive income streams in comparison with guaranteed annuities but one would need to assume respective minimum final year ruin percentages of 30% and 25% for single and joint-life retirees respectively. These strategies provided respective terminal values equal to 30% and 36% of the total present value earned. It is important to stress that the living annuities could not provide such income streams for all retiree cases.

In conclusion, it appears as though living annuities are retirement products for those who can 'afford' it and who have sufficient financial knowledge. The products should never be purchased simply because of the bequest possibility or because one can obtain a much higher initial income by drawing 17.5% of the underlying capital. It is recommended that these products only be used as an additional source of income on top of a guaranteed annuity or some other form of income. The retiree should also initially only draw 2.5% and can marginally increase this rate at a later stage.

6.2.4 Other Concluding Remarks

When one decides to start planning and providing for retirement remains a personal decision. It is unfortunate that we live in a world where retirement only becomes a priority for many when it is already too late. Therefore it is thought that perhaps the underlying success of the retirement products available does not lie with the reform of these products or the industry, but rather in the minds of the purchasers.

If it was possible to develop a retirement savings culture across the world, many of the problems surrounding insufficient retirement capital could possibly be resolved. Criticism of retirement products, and living annuities in particular, should be seen in the context of the retiree's discipline of monthly savings throughout his lifetime. It appears that we regrettably live in a world where people find it more important to match their neighbour's lifestyle than to live within their means.

6.3 Limitations of the Study

As with all research studies there are certain limitations to the results obtained. It should be noted that only an initial retirement amount of R1 000 000 was assumed in this study. Other approaches are also available.

The bequest motive was also not explicitly tested in this study, yet the terminal value results were used in drawing certain conclusions from the study. One could also argue that a retiree who nears the 17.5% drawdown cap will intervene and reduce his drawdown. This was not tested in the study. The ruin probability measurement also does not take into account the extent of the shortfall.

The annuity rates were subject to interest rates as at the beginning of 2015. The argument can be made that in periods of high interest rates the annuities will provide higher and thus more attractive income streams.

Different discount rates can also be used which will impact the final results. This study only made use of inflation as a discount rate.

It is also acknowledged that more advanced living annuity portfolios, such as absolute return funds, could be simulated. Furthermore, it is important to note that the investment return modelling which this study employed can be improved on significantly. Life insurance companies make use of advanced and expensive asset modelling software, whereas the model used in this study is a basic solution to investment return simulations.

Finally, one may argue that the inflation rates simulated in this study were not subject to the 3% to 6% target as set by the central bank due to the fact that simulations were based on historic rates. However, it would seem as though we are entering a period of higher inflation rates and that South Africa, specifically, is likely to see a period of relatively high inflation and possibly stagflation (Barry, 2015). Still, the TCPP annuity provided similar income streams and present values to the inflation-linked product and inflation is not explicitly used in determining the increase in income of this product.

6.4 Future Research

It is suggested that future research should analyse whether or not living annuitants could perhaps have a certain risk measurement instrument that would warn them when they start to draw too much from the underlying fund. This would require sophisticated algorithms and asset modelling software. The sustainability of living annuities might lie in varying the drawdown rates.

It is also argued that future research should pay more attention to inflation-linked annuities. Though they provide the lowest initial income of all guaranteed annuities, and are therefore unpopular amongst retirees, one could potentially find value in these products if they exhibit promising income structures and present values.

This study also showed that the TCPP product could be considered by retirees. This is a relatively new product and shows that one does not have to accept the *status quo*. New products could provide retirees with better options that match their needs and circumstances. It is advised that researchers attempt to find different product structures that would appeal to retirees.

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APPENDIX A

Cholesky Decomposition Code:

The code below can be pasted into Excel as is. The code works with a covariance matrix, so it is necessary to create such a matrix first. Depending on the size of the matrix one would select, for example, a 6 x 6 matrix of empty cells. In the first cell (1 x 1) enter: =Cholesky (range of the covariance matrix). By pressing Ctrl + Shift + Enter one then enters this formula into the 6 x 6 matrix as an array. The Cholesky matrix should then appear.

Public Function Cholesky(mat As Range)

Dim a, L() As Double, S As Double

a = mat

N = mat.Rows.Count

M = mat.Columns.Count

If N <> M Then

Cholesky = "?"

Exit Function

End If

ReDim L(1 To N, 1 To N)

For j = 1 To N

S = 0

For K = 1 To j - 1

S = S + L(j, K) ^ 2

Next K

L(j, j) = a(j, j) - S

If L(j, j) <= 0 Then Exit For

L(j, j) = Sqr(L(j, j))

For i = j + 1 To N

S = 0

For K = 1 To j - 1

*S = S + L(i, K) * L(j, K)*

Next K

L(i, j) = (a(i, j) - S) / L(j, j)

Next i

Next j

Cholesky = L

End Function